Review of the Beauforth Sea Drilling Program

Indian and Northern Affairs Canada
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REVIEW OF THE 1980 BEAUFORT SEA DRILLING PROGRAM

Northern Affairs Program

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OBJECT

1. As directed by Cabinet in May 1976, and confirmed by Cabinet in Spring, 1980, Dome Petroleum Ltd.'s Beaufort Sea Drilling program conducted by Canadian Marine Drilling Co. (CANMAR) has been subjected to an annual comprehensive review. This report informs Cabinet of the findings from a review of social-economic- cultural matters, environmental impact and technical aspects of Dome Petroleum/CANMAR's 1980 operations in the region of the Beaufort.

BACKGROUND

2. In 1973 Cabinet gave approval in principle to offshore drilling operations in the Beaufort Sea.

3. In April, 1976 Cabinet granted approval of the initial drilling program proposed by Dome Petroleum Ltd. and its wholly-owned subsidiary, Canadian Marine Drilling Ltd. (Dome/Canmar) for the mid-1976 season.

4. The 1976 drilling program was subjected to a comprehensive review by officials of relevant government departments in the winter of 76-77. In May 1977, Cabinet accepted the report of that review, submitted by the Minister of Indian Affairs and Northern Development (DIAND). At the same time Cabinet approved public release of the Minister's report and also approved exploratory drilling in the Beaufort Sea for the three-year period 1977-79 inclusive, subject to revised conditions for determining the length of the operating season and to the following provisions:

   (a) That an annual report be provided to Cabinet by the Minister of Indian Affairs and Northern Development on the previous year's drilling operations.

   (b) That the Minister of DIAND develop, in co-operation with the operator and the Beaufort Sea Community Councils, social and economic

operating conditions. In the event that the operator failed to comply with such terms and conditions, the Minister would be authorized to suspend drilling operations.

(c) That the government accept as a matter of priority the principle of providing a same-season relief well capability for all offshore drilling in Arctic waters.

5. In May 1978, Cabinet accepted the Minister of DIAND's report on the 1977 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1978 subject to the same conditions approved in 1977 with the following changes:

(a) the social-economic commitments with respect to the northern elements of the Dome/Canmar Drilling program would be agreed to between the Company, and the Government of Canada by means of a Memorandum of Understanding in lieu of the formal agreement adopted in 1977;

(b) the start of drilling operations would be authorized by the Minister of Indian Affairs and Northern Development as early as, in the joint judgement of the shipmasters of Dome/Canmar's vessels, ice conditions at overwintering harbour, marine supply routes and well site could safely permit;

(c) the definition of "deep" and "shallow" wells would be governed by site specific data on each well as to the threshold depth of potential hazard of blowout, that is the threshold depth for each well above which no oil or significant amounts of gas are anticipated.

(d) with respect to shutdown in 1978, "deep" wells would be terminated seven days prior to the forecast closure of Beaufort Sea operations, based on predicted weather and ice conditions, or by midnight September 25th whichever is earlier; and in respect of special circumstances, an extension of up to 10 days would be allowed for drilling and/or other operations in any deep well;

(e) for 1978, drilling and setting casing in "shallow" wells be permitted after September 25 but terminate 48 hours prior to midnight, December 5. At least one Arctic Class 2 supply boat would be committed to an operating drillship up to the formation of grey-white ice and thereafter at least two Arctic Class 2 supply boats;

(f) the Department of Transport would have available on a standby basis in the eastern Arctic during late September 1978 and 1979, a near Arctic Class IV icebreaker to assist, if required, in relief well drilling in the Beaufort Sea;

(g) with respect to shutdown of drilling "deep" wells in 1980 and future years, the government would make no decision pending review at the appropriate time of the demonstrated capabilities of the drilling systems and of contingency measures under conditions of worsening ice and increasing darkness late in the 1978 and 1979 seasons;

(h) the navigation/operation of Canmar's drilling fleet in the Beaufort Sea (zone 12) be permitted irrespective of full capacity load of fuel oil on board, and that the Arctic Shipping Pollution Prevention Regulations be so amended to incorporate the appropriate navigation time provisions to accommodate the Canmar fleet and any other ship of the same class.

6. In May, 1979, Cabinet accepted the Minister's (DIAND) report on the 1978 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1979, subject to the same conditions established for the 1978 season, with the following changes:

(a) with respect to start-up in 1979, operations could commence as early as June 10;

(b) with respect to end of season shutdown of "deep" wells, an extension of up to 20 days could be allowed by the Minister (DIAND) or his designated official, for drilling and/or other operations;

(c) drilling and setting casing in "shallow" wells would be permitted until December 31 provided that the drillship were accompanied by two Arctic Class 2 vessels, and in addition one Arctic Class 3 vessel after December 5.

7. In May, 1980 Cabinet accepted the Minister's (DIAND) report on the 1979 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1980, subject to the same conditions established for the 1979 season, with the following changes:

(a) the starting of drilling operations in "shallow" wells could be authorized by the Minister of Indian Affairs and Northern Development as early as practical in the spring, but not before May 1st and should terminate by December 31.

(b) "Deep" well operations could be undertaken as early as June 10, and should terminate by midnight, September 25. An extension of up to 20 days may be allowed by the Minister of DIAND or his designated official, in consultation with the Minister of the Environment and the Minister of Energy, Mines and Resources, or their designated officials, for drilling and other operatons in open hole.

(c) A drillship operating at a well site should be accompanied by at least one Class 2 vessel before July 1st and after September 25 when ice is present; by at least two Class 2 vessels before June 15 and after the formation of grey-white ice; and by at least two Class 2 vessels and a Class 3 vessel before June 10 and after December 5.

(d) The Minister of DIAND indicate to Dome/Canmar the importance of increased Research and Development efforts by the Company in improving the efficiency of its oil spill containment and clean-up capability in the Beaufort.

(e) Cabinet's annual review and approval of Dome/Canmar's operations in the Beaufort Sea should be maintained.

8. The Beaufort Sea Steering Committee has again reviewed the technical, environmental, and social-economic-cultural aspects of the 1980 operations. The Steering Committee was chaired by a senior official of DIAND, with representation from the Departments of Energy, Mines and Resources; Transport; Industry, Trade and Commerce; Environment; Fisheries and Oceans; External Affairs, and the Government of the Northwest Territories.

FACTORS

9. The following paragraphs set out the major findings of the 1980 review.

10. Dome/Canmar operated in the Beaufort Sea in 1980 with a fleet of four ice-reinforced drillships (Canmar Explorer I to IV), one 26,000 ton cargo carrier, one class 3 ice-breaking supply boat (Canmar Kigoriak), four class 2 ice-breaking and four other supply boats (Canmar Supplier 1 to 8), several barges and two dredges (Aquarius and Geopotes X).

11. The Company's total expenditure for 1980 in the Beaufort Sea was approximately $168 million. Of this amount, $133 million was spent on operating costs, and $35 million was spent on capital expenditures.

12. In addition to the drilling activity, artificial island construction was begun at two sites, Tarsiut and Kaglulik. The Geopotes X, a large trailer suction dredge, was chartered and arrived in the Beaufort Sea in September to assist in the island building program.

13. During the 1980 operating season, several major projects were undertaken by Dome/Canmar to improve the efficiency of its overall exploration venture. All of the drillships were modified to improve their performance in ice. The Explorer I and Explorer II were extensively modified. Dome

continued to improve its facilities at Tuktoyaktuk and at McKinley Bay. The logistics base at Tuk was expanded to improve accommodation, warehousing, transportation and communication facilities. Dredging activity continued at McKinley Bay, the winter mooring basin for drillships and supply vessels, to develop a more suitable winter anchorage and forward supply point for early and late season drilling activities.

14. During the 1980 drilling season, drilling operations were conducted at the following 7 wells: (See Appendix I, for comprehensive summaries of each well and Figures 1 and 2 for well locations and deployment of fleet.)

    a) Dome et al Killannak A-77
    b) Dome Gulf Tarsiut A-25
    c) Dome Gulf Hunt Koakoak O-22
    d) Dome Gulf Hunt Kopoanoar I-44
    e) Dome Gulf Hunt Kopanoar 21-44
    f) Dome Hunt Kenalooak J-94
    g) Dome Superior Orvilruk 0-03

Technical Summary

15. Government Surveillance; Compliance with Drilling Program Approval, Drilling Authority, Drilling Regulations

    (a) Inspectors from the Regional Office, Yellowknife, were assigned to maintain constant surveillance of Beaufort Sea operations. They were supported by officers jointly monitoring the operations in Yellowknife and Headquarters, Ottawa, on 24-hour stand-by. Government surveillance during the 1980 season was performed on a rotational basis with one Inspector on each drillship during the portion of the season when ice hazards were acute, and with one Inspector in Tuk Base and one Inspector circulating among the ships during periods of low ice frequency. Officers of Water Resources, D.I.A.N.D., and Environmental Protection Services, D.O.E., conducted periodic inspections of the vessels for

compliance under the Environmental Operating Conditions. The Canadian Coast Guard (Transport Canada) conducted routine and special safety inspections on the Dome/Canmar fleet, examined the strengths and weaknesses of the fleet, and assessed the capabilities of ship management and navigation modes under varying conditions of weather, sea and ice. Deficiencies with respect to safety, good drilling practices or environmental concerns were noted and generally rectified promptly.

(b) Dome/Canmar's operations in the Beaufort Sea are controlled by the Canada Oil and Gas Drilling Regulations which were promulgated in January 1979 and amended in 1980 with regard to housekeeping items and to more clearly define the provisions relating to ice platforms, artificial islands, size of helicopter decks, surface casing setting depth and choke manifolds.

(c) Pending amendment of the Regulations effected on July 31, 1980, orders were issued by the Regional Conservation Engineer in Yellowknife on two occasions to prohibit landings of Sikorsky S-61 helicopter on the decks of Explorers I, II and IV. Following assessment by officials of the Department of Transport, the Sikorsky S-61 was authorized to operate from the helidecks subject to specific further conditions affecting the safety of operations. These conditions were met for the remainder of the season.

(d) The Regional Conservation Engineer issued an order on August 10, 1980, prohibiting the drilling ahead at the Kopanoar 2I-44 well. Dome had been given verbal approval to spud this well after the Kopanoar I-44 well had been abandoned due to high pressure water sand and surface casing cementing problems. Dome neglected, as an oversight, to submit their formal Application for a Drilling Authority for the new well (K2I-44) although they were given ample time to rectify the situation. The Drilling Authority application for the well was hand delivered immediately after the Company received the shut-down order.

16. Prior to the 1980 Beaufort Sea drilling season, Dome/Canmar had been issued seventeen Drilling Authorities and had undertaken operations at fifteen locations. Of these fifteen wells, four are oil and/or gas discoveries, five were abandoned or suspended due to either mechanical hole problems or uncontrollable water flows, and six were suspended for future operations.

    In 1980, twelve Drilling Authorities were issued or re-issued, with operations taking place at seven locations. Three wells, suspended in 1979, were re-entered and four new wells were commenced. Wells authorized for five locations were not spudded. Two wells were abandoned and five wells remain suspended for further operations in 1981.

    The result of five seasons' operations by Dome/Canmar is four discoveries: Nektoralik K-59 (oil and gas, 1977); Kopanoar M-13 (oil and gas, 1979); Ukalerk 2C-50 (gas, 1979); and in 1980, the oil and gas discovery Tarsiut A-25.

17. All drilling operations for 1980 are summarized in Appendix I. Excluded from this discussion are drillstem tests, geologic, geophysical and related privileged data, which, under legislation, are held confidential for two years after completion of a well.

18. The four drillships broke out of winter harbour at McKinley Bay in mid-June and Explorer III commenced drilling at the Kilannak A-77 location on June 23rd, the earliest in five years. However, ice conditions encountered late season this year were the worst experienced since commencement of drilling in 1976. Multi-year floes moved southward from the polar pack in mid-September hampering operations at well sites, essentially terminating drilling activities on September 25th. An effort was made with the Explorer I to re-enter Kopanoar 2I-44 before the final cut-off of deep drilling October 15th. However it was unsuccessful and Explorer I joined the other three drillships for wintering at McKinley Bay on October 13th.

19. Despite the adverse ice conditions at the start and at the end of the 1980 drilling season, the footage drilled was approximately the same this

year as when operations commenced July 4th and terminated November 28th, and an improvement over 1978 when the season commenced July 6th and ended November 4th (see Appendix I, Figure 2). Drilling and/or testing proceeded at seven wells. Oil was discovered at Tarsiut A-25 and tested at a rate of 125 m^3/day. The Kopanoar 1979 oil discovery step-out well, 2I-44, was drilled to within 150 metres of the original oil reservoir. Koakoak O-22, Orvilruk O-03, and Kenalooak J-94 were suspended approaching the final stages of drilling. These promising structures will be tested before year end in the 1981 Beaufort Sea season.

20. Shallow high pressure water sands continued to create drilling problems at the Kopanoar oil pool. Last year, the loss of the Kopanoar L-34 step-out well, due to subsidence of the wellhead, was considered to arise from contamination of cement resulting in unsatisfactory cementing and setting of the conductor casing. Consideration was given also to the cementing of this string of casing in two stages and grouting with additional heavy slurry cement to adequately secure the casing. After the failure of the first attempt this year in drilling a step-out well at I-44, the 2I-44's casing design included an additional string of casing that sucessfully sealed off the high pressure water sand. Testing of the well in 1981 will be significant in further assessment of the Kopanoar oil discovery of 1979.

21. Drilling conditions in the Beaufort Sea are complicated by various other difficulties such as geopressures, hydrates, swelling clays and slow rates of penetration. As a consequence, special and cautious drilling procedures are required. Blowout prevention continues to be a priority requirement for drilling crews and equipment. Kick Tolerance Procedures adequately maintained margins of safety to both control high pressures and prevent sudden influxes of formation fluids into the wellbore. A 5 m^3 kick of gas at Orvilruk O-03 was promptly identified and controlled with a negligible amount of lost time. As well, the introduction of turbo-drilling at this location effectively doubled the rate of

penetration in a medium-hard section of the hole. With the exception of ice conditions, swelling shales in the wellbore are presently causing the greatest amount of lost drilling time. The most notable instance of swelling shales occurred at Koakoak O-22, where more than two weeks were required to run the surface casing to a depth shallower than originally programmed.

Sea, ice and weather conditions were such that Dome did not undertake further deep drilling operations after September 25th and terminated all well operations by October 13th. All the wells were formally suspended with the exception of Orvilruk O-03. The well, however, with the B.O.P. still in place, is considered adequately shut-in and secure for the winter.

22. In addition to drilling activities, Dome commenced dredging and placing of material for construction of artificial islands at two locations using the "Aquarius" and the newly acquired "Geopotes X" dredging vessels. These two sites are proposed to be drilled utilizing a unique man-made island requiring a steep sloped sub-marine berm, and topped above sea level with a concrete caisson rim infilled with sediment. From the artificial islands, delineation drilling is proposed at the Tarsiut discovery in the winter of 1981 and possibly an exploratory well at the Kaglulik location in late 1982. However, at this time, the operator has yet to demonstrate to the satisfaction of the Regulatory authorities that there is adequate same-season relief well capability to permit drilling from the island locations through the winter/spring period.

23. In 1980 more experience was gained in ice management to permit drillships to be maintained on location with minimum interruption to drilling operations. Although releasing from the well to avoid potentially hazardous ice was necessary on numerous occasions, damage was sustained only during one release. Repairable riser damage occurred at Kenalooak J-94 because the ice reconnaissance officers were unable to detect and give early warning of an impending hazardous ice condition. Accordingly the Ice Alert Procedures were revised to treat even doubtful ice-threat situations as hazardous.

Dome has not adequately demonstrated the ice management capacity of the drilling systems to continue operations where multi-year ice threatens and invades well locations. However, strict adherence and constant revision to Ice Alert Procedures, including improved ice detection systems, has served to avoid any major marine mishap.

24. The overall accident frequency rate (lost-time accidents per million man hours worked) for Dome's 1980 operations was 22.50, compared to 12.96 in 1979 and 9.62 in 1978. The accident frequency rate for the drill systems only was 23.87 which compares favourably to 1980 drilling accident frequency rates in Alberta (73.90) and the U.S.A. offshore (40.83). Although the number and frequency of accidents were up slightly from previous years, there were no permanently disabling accidents.

Environmental Summary

25. The environmental conditions for Beaufort Sea drilling are established under the Arctic Waters Pollution Prevention Act. The Environmental Operating Conditions are attached to the comprehensive annual "Drilling Program Approval" and to the "Drilling Authority" specific for each well. Environmental monitoring of the operation was carried out by Pollution Prevention Officers from Indian Affairs and Northern Development and Environment Canada.

26. The wells at Tingmiark K-91 and Kopanoar D-14 have exhibited uncontrolled gas/water leakage in past years and in 1980 Dome/Canmar again carried out surveys at these two sites. A visual survey of the Kopanoar location revealed that gas is seeping from the well and percolating to the surface. The flow of fluid from the Tingmiark well has ceased.

27. Dome and Gulf Canada Ltd. applied for and were granted Program Approval for the construction of two artificial islands in the Beaufort Sea. The operators intend to apply for permission to drill exploratory wells from the islands. Environmental Program Approval was given under the Arctic Waters

Pollution Prevention Act and leases under the Public Lands Grants Act were granted for the two sites with environmental conditions covering construction, operation, maintenance and abandonment. Approval under the Navigable Waters Protection Act was granted in October 1980 by Transport Canada to construct these islands. Only limited construction took place in 1980 with completion of the first island scheduled for 1981 and the second island for 1983.

28. Ice movement in the overwintering basin at McKinley Bay caused damage to some vessels so Dome was granted permission to dredge an additional 3 km. of access channel and a new mooring basin. The excavated material was used to form an artificial island, the use of which will be subject to strict environmental controls to prevent pollution of the marine environment of the Bay. Dredging was also carried out to maintain and improve the Tuktoyaktuk Channel and Harbour.

29. The environmental studies program carried out from 1974 to 1976 prior to commencement of drilling concluded that the greatest threat to the marine environment of the Beaufort Sea was from the accidental, uncontrolled spillage of oil. In the circumstances, a great deal of effort and money has been spent by government and industry to learn more about the behaviour of oil in ice and ice infested waters and to advance the technology for containing and cleaning up oil in the arctic marine environment. During the winter of 1979-80 Dome carried out experiments in land-fast ice to learn more about oil/water/ice interactions. While the removal efficiency for spilled oil was high (80%-90%), the tests were carried out under controlled conditions and involved small amounts of oil. The experimental spills occurred in land-fast ice, not in the transition zone where the drillships operate. The results are encouraging, but the tests should not be construed as providing conclusive answers for containing and cleaning up a major oil spill.

Social-Economic-Cultural Summary

30. The Company continued its program of northern employment and training, use of local services and business, social and cultural activities, and information and communications.

31. The 1980 season proved to be Dome/Canmar's most successful in their Northern Employment program: more Northerners were employed, more skilled and semi-skilled positions were filled by Northerners, more stayed on the job over a longer period of time with more completing the season and earning end-of-season bonuses.

32. In 1980, 338 persons were hired to fill 194 positions compared to 224 hired to fill 130 positions in 1979. This represents an increase of 166% in persons hired from 1976 to 1980, and a 94% increase in positions over the same period of time. As in past years the greatest number of these employees came from Tuktoyaktuk and Inuvik (62%) followed by other Beaufort Sea communities (20%). Eighteen percent were recruited from outside the area.

33. Over the past years Dome/Canmar's training programs, formal and training-on-the-job, have provided an increased workforce of skilled and semi-skilled northerners. In 1976, 22 employees were classified as skilled or semi-skilled. By the 1980 season this number had increased by 682% to a total of 172 persons. The number of unskilled employees has steadily increased as well from 105 in 1976 to 166 in 1980. Between the 1979 and 1980 drilling seasons there was a 39% and 83% increase in the number of skilled and semi-skilled employees, respectively. The number of unskilled employees increased by 50% over the same period of time.

34. Earnings of northern employees of Dome/Canmar have continued to increase reflecting the increased skill levels and longer drilling seasons. In 1979, the average seasonal earnings were $9,119 increasing by 14% in 1980 to $10,355. The percentage increase in earnings from 1976 to 1980 is 247%.

35. On-the-job training programs have continued to be the primary means of employee development. In addition to existing programs, during 1980, Dome/Canmar instituted a specialized drilling training program on each of the four drillships providing on-the-job training for all employees.

With the participation of the N.W.T. Government and Canada Manpower, extensive training programs were conducted at Dome's Tuk base camp and Information Centre in office practices, heavy equipment operations and in basic seamanship. These courses were not restricted to current employees but included other persons to provide them the opportunity to prepare themselves for employment with Dome/Canmar or with others.

As well, Dome brought in a Business Education Instructor from Calgary, to conduct a Seminar for their female employees in areas of money management.

36. To complement existing training programs i.e. training-on-the-job, apprenticeships, etc., a successful off-season program has been implemented. During the 1980 winter months, 39 employees attended various courses across Canada with 30 successfully completing their courses and being re-employed by Dome/Canmar.

37. Offshore oil exploration appears to have had little negative impact on hunting and trapping activity during the past number of years in the Beaufort Sea communities.

38. Dome/Canmar has continued to take into consideration their Northern employees' desire to participate in renewable resource harvesting activity. Lay-offs tend to occur just prior to the opening of the hunting and trapping seasons and those who continue to work have been able to utilize time off and rotation schedules to participate in hunting and trapping.

39. Social assistance for economic reasons in the Beaufort Sea communities decreased by 12% during the 1980 summer months from an average high of 43 case months per 1000 population during the winter months of 1979-80. The majority of child care cases occur during the summer months, probably resulting from less parental supervision and general boredom of the children.

40. Dome/Canmar continued its support of the Alcohol Centre, Day Care Centre, and a bank in Tuktoyaktuk. They offered to sponsor a community resource person for the Hamlet.

41. Dome/Canmar continued its "dry - camp policy" and supervised employee access to Tuktoyaktuk.

42. The Company continued cultural support by sponsoring four Tuktoyaktuk residents to a cultural exchange in Calgary in conjunction with the Roman Catholic Mission, and one resident to the Canadian Symposium on the History of the Arctic Islands.

43. Dome/Canmar also continued their supervisory pre-season orientation seminars.

44. The Company provided support and material and financial assistance to a number of community and social organizations, such as Fort Norman Anglican Church Restoration, Tuk Radio Society, NWT Ski Team, Tuk arena, Arctic Winter Games, NWT Teachers Conference, and others.

Financial Considerations

45. For 1980 the total expenditures, capital and operating, incurred to support the Dome/Canmar drilling program were $168 million. Of this total, approximately $143 million, or 85% of the total, was spent in Canada. Of the $35 million spent on capital expenditures, $31 million was spent in Canada creating an impact on the Canadian economy of $93 million. Approximately 85% of the $133 million in operating expenditures was spent in Canada on Canadian goods and services. The total impact of this operating expenditure in Canada is estimated to result in excess of $337 million in Canadian income.

46. The Company spent $8 million of their operating expenses on research services including environmental studies, research and development costs and services provided by governmental agencies. All services were obtained from Canadian sources.

47. For periods of varying durations, the Company employed approximately 1,150 individuals in the Beaufort operation at a cost of $34.6 million. Of this total, all but approximately 5% were Canadians. Included in this 5% were specialized

dredging personnel from Holland working on the two dredges (Aquarius and Geopotes X). It is estimated that the total direct and indirect employment created by the various operations is in excess of 5,000 man-years of employment, essentially all in Canada.

48. A total of 338 northern residents were employed throughout 1980 with 194 of these employees filling regular full-time positions. Of the 194 employees, 145 completed the season and received season-completion bonuses.

49. Dome/Canmar's 1980 expenditures to 132 small locally owned businesses totalled $11,525,930 (to November 31/80). In addition, the Company paid $10,335,870 to seven large companies with Branches in the North. Dome/Canmar also spent $829,019 in the Yukon Territory to six locally owned companies, one in Dawson City and five in Whitehorse.

International Aspects

50. United States authorities continued to follow closely the Canadian Beaufort Sea drilling operations in 1980 in keeping with their previously expressed concern regarding the potential for environmental damage for a blowout at the Beaufort Sea drill sites.

51. A fifth round of consultations with the U.S. was held in the spring, 1980 in Washington. In addition to reviewing the past season, the meeting exchanged information regarding the environmental and socio-economic impacts of exploration and development, methods of regulation, and systems of transportation that might be employed for the removal of hydrocarbons from the Arctic.

52. An invitation will be extended to the U.S. side to meet in Ottawa in late Spring 1981 to review the 1980 Beaufort Sea program.

FEDERAL-TERRITORIAL RELATIONS

53. Senior officials of the Government of Northwest Territories and the Yukon Territory have been kept apprised of the drilling program in the Beaufort

Sea throughout the 1980 drilling season. The N.W.T. Government had membership on the Steering Committee formed by DIAND to conduct the review of 1980 operations and chaired and staffed the sub-committee that reviewed the social-economic-cultural impact of the 1980 drilling program.

INTERDEPARTMENTAL CONSULTATION

54. The Department of Indian Affairs and Northern Development again created an intergovernmental, interdepartmental Steering Committee to conduct the 1980 Beaufort Sea drilling program review. Interested Departments participated in the review process and have been consulted with respect to this report.

PUBLIC INFORMATION

55. During the 1980 drilling program, the Beaufort Sea Community Advisory Committee was kept informed on all aspects of the drilling program. The BSCAC is comprised of representatives from the seven Beaufort Sea communities (Inuvik, Aklavik, Tuktoyaktuk, Sachs Harbour, Holman Island, Paulatuk and Coppermine). The BSCAC visited all the Beaufort communities at the end of the 1980 drilling season and held public meetings with the local residents to pass on information and to elicit comments and concerns. The BSCAC members continued to report to their individual Councils and Hunter and Trapper's Associations to provide continuous communication at the local level. Dome/Canmar's Information Centre in Tuk was moved and expanded to include a permanent local contact office. Company personnel met with the Tuk Council, Tuk Hunters and Trappers, Inuvik Council and Chamber of Commerce, and Territorial Government officials on a regular basis throughout the 1980 drilling season.

56. A total of 183 northern residents and government representatives visited Dome/Canmar's operation in 1980. In addition, 195 visitors came from southern Canada, including the Prime Minister, the Governor General, and two members of the Alberta Cabinet.

CONCLUSIONS

57. The Arctic Class 3 Icebreaker Kigoriak demonstrated that it is capable of operating in first-year unpressured ice of up to 1.5 m thick in a continuous icebreaking mode.

58. The present complement of drilling vessels and support systems is insufficient for uninterrupted conduct of operations in the presence of multi-year ice.

59. Ice Alert Procedures were followed effectively, notably avoiding a possibly hazardous situation at Kopanoar 2I-44. However, an incident at Kenalooak J-94 demonstrates that difficulties remain with the ability to detect and predict ice that may present a hazard to drilling operations.

60. Dome/Canmar successfully penetrated the shallow water sands, and provided for integrity of Kopanoar 2I-44, by utilizing an additional shallow string of casing.

61. "Kick Tolerance Procedures" coupled with pre-drill velocity analyses enabled adequate control and prediction of abnormal pressures.

62. An oil reservoir discovered at the Tarsiut A-25 well has potential for commercial development. Further assessment of the areal extent of the reservoir by drilling of delineation wells is required.

63. Orvilruk O-03, although satisfactorily shut-in, was not properly suspended for the winter.

64. Dome/Canmar is engaged in the building of artificial islands at the Tarsiut and Kaglulik sites which, with success in the use of new island contruction techniques, may allow drilling by the winter of 1981.

65. Dredging of McKinley Bay and Tuk Harbour will further improve logistics and thereby will facilitate access to drillsites for an earlier start-up and later safe closing-down of operations.

66. The level of Government surveillance at Yellowknife and Ottawa and formal inspections carried out from Tuk Base was effective and sufficient.

67. The accident frequency rate, although considerably below comparable statistics for land and offshore drilling operations, increased in 1980 from previous years. Constant effort is necessary to improve training of workers and to schedule regular periodic safety drills.

68. Dome/Canmar's overall compliance with the environmental operating conditions is considered to be satisfactory. In the area of spill reporting and clean-up preparedness, the Operator's performance is better than satisfactory.

69. Improvement is needed in the communication of environmental requirements to all personnel, although as the season progressed, individuals become more aware of and familiar with the conditions.

70. In the sample results reported, the oil/water separators met the required standard of 50 mg./l only 64% of the time. It appears that maintenance problems and lack of spare parts caused the poor performance of this equipment which the manufacturer claims is capable of achieving an effluent standard of 10 mg./l of oil and grease content.

71. Dome/Canmar more than satisfactorily met the spirit and terms of the 1979 Memorandum of Understanding and the 1980 action plan drawn up by the Company.

Recommendations resulting from the Technical Review

It is recommended that:

1. The Operator continue efforts to perfect the quick disconnect systems, including the anchor releases, the riser connectors, the blow-out preventor mandrels, and that practice drills be held to train the crews and check the equipment.

2. The Operator continue with efforts to improve the well design and practices for penetrating and cementing of casings through shallow water sands.

3. The Operator persist with efforts to obtain better quality logs to enable reliable geological and reservoir evaluations and continue to improve remedial practices to reduce the problem of sands interfering with production testing tools.

4. The Operator continue to adhere strictly to Ice Alert Procedures and further improve techniques and procedures for ice detection.

5. The operator continue efforts to improve safety and training programs to take into account the expansion of the workforce due to the growing demands of development in the Beaufort.

6. The government monitoring program for 1981 remain the same as 1980 and the Region re-establish its Inspector's office at Dome's Tuk Base.

Recommendations Resulting from the Environmental Review

It is recommended that:

1. The oil/water separators be maintained and serviced so as to attain their maximum effectiveness and efficiency.

2. The 1980 effluent standard of 50 mg./l oil and grease content be reviewed in the context of a more stringent standard.

3. Routine sampling of drilling fluid be re-examined in relation to a comprehensive, long range impact assessment study.

4. The companies operating in the Beaufort Sea continue to carry out research in behaviour of oil in arctic marine environments, the containment of spilled oil and the clean-up and disposal of the oil.

Recommendations Resulting from the
Social-Economic-Cultural Review

It is recommended that:

1. Because the net social and economic effects of Dome/Canmar's exploration efforts appear to be positive, the Company should be encouraged to continue operations in the Beaufort Sea.

Appendix I

Summary of Drilling Operations

Drilling Summary

Current status of Drilling Authorities in effect in 1980 drilling operations including new authorities (*), and those extended from previous years are:

		D.A.	Status
1.	Dome et al Kilannak A-77	966*	Suspended
2.	Dome Gulf Tarsiut A-25	910	Abandoned oil & gas well.
3.	Dome Gulf Hunt Koakoak 0-22	946	Suspended
4.	Dome Gulf Hunt Kopanoar I-44	964*	Abandoned
5.	Dome Gulf Hunt Kopanoar 2I-44	967*	Suspended
6.	Dome Hunt Kenalooak J-94	909	Suspended
7.	Dome Superior Orvilruk 0-03	962*	Suspended
8.	Dome Texaco et al Uviluk P-66	963*	Not spudded
9.	Dome Hunt Miterk I-44	965*	Not spudded
10.	Dome Gulf Hunt Kopanoar H-95	969*	Not spudded
11.	Dome Gulf Kudjug B-39	970*	Not spudded
12.	Dome Gulf et al Tingmiark E-79	971*	Not spudded

1) Kilannak A-77 (figure 3)

The well was spudded from Explorer III on June 23, 1980. Drilling conditions were normal; however, ice conditions on two occasions required the drilling vessel to terminate drilling operations and to stand-by the location. Explorer III left the well suspended on July 9th. The well was re-entered using the same drillship on September 10th and was drilled to 702 m towards an approved total depth of 3048 m. A DLL-MICRO SFL Log was run before 508 mm casing was set to 559 m. The well was suspended on September 18th and awaits re-entry in 1981.

2) Tarsiut A-25 (Figure 4)

The well was re-entered from Explorer III on July 13, 1980, to further evaluate the drilled hole that had been tested from deep zones in 1979. Seven production tests were conducted, one

of which was a misrun due to sanding problems that plugged the testing tool. The Operator announced that an oil production interval approximately 50 m thick was discovered at the upper interval 1487-1536 m and flowed at a maximum rate of 125 m^3/day. There were indications of hydrocarbons in the lower part of the hole and future drilling should penetrate these sands to ensure further geologic evaluations and testing. The well was plugged and abandoned, and classified as an oil and gas well, on July 30th. A delineation well to evaluate this discovery will be drilled in 1981-82 from an artificial island.

3) Koakoak O-22 (Figure 5)

The well was re-entered from Explorer I on July 7, 1980, having been drilled to a depth of 210 m in 1979. Drilling proceeded to 1900 m but during the running of the 340 mm casing the casing became stuck. Three attempts were made to retrieve and re-run the casing, losing a total of seventeen days to these operations. The problem was caused by differential sticking of the casing and by sloughing shales that bridged off the hole. Ultimately the 340 mm casing was landed and cemented at 999 m.

Mechanical logs were run to a total depth of 3718 m. Log quality was generally poor towards the bottom of the hole due to borehole conditions. Samples were collected every 10 m from 210 m to final drilled depth. Ninety-five sidewall cores were attempted with ninety-one recovered. No zones were tested. Pre-drill velocity analysis of conventional seismic data was adequate to predict the pressure gradient of the well. The Operator announced that electric logs and core data showed reservoir sands with indications of oil and gas in the lower part of the hole.

On September 17th, ice invaded the location forcing the Explorer I to disconnect the lower marine riser from the B.O.P.'s and to wait two weeks for an opportunity to re-enter the well. On October 5th, an urgent suspension program

required leaving the open hole section to a depth of 3718 m not plugged but the well safely suspended with the rams closed in the B.O.P. The well will be re-entered in 1981.

4) Kopanoar I-44 (Figure 6)

To better define the Kopanoar oil structure, I-44 was spudded from Explorer II on July 10, 1980. All wells drilled in the Kopanoar structure have encountered similar problems of unconsolidated shallow sediments and high pressure water sands. The conductor pipe was landed at 200 m and cemented to surface. A combination of lost circulation zones at 200 m and 300 m, and water flows at 477 m and 517 m, was controlled with lost circulation material and increased mud densities respectively. The 508 mm casing was landed at 643 m and cemented. However, a temperature survey indicated that the well was flowing water behind the casing from two zones. The casing was perforated at 474-76 m and a high density slurry of cement was pumped into the formation successfully curtailing the water flow. As the integrity of the well was doubtful, it was abandoned on August 1st, and a well was commenced offsetting the abandonment approximately 1 km to the west.

5) Kopanoar 2I-44 (Figure 7)

This step-out well at a location approximately 4 km west of the M-13 discovery was spudded from Explorer II on August 2, 1980. In order to seal off the predicted high pressure water zones, an additional shallow string of casing, 406 mm, was incorporated in the well design. The 508 mm conductor casing was run and cemented to surface at 422 m and the 406 mm casing was cemented at 859 m successfully controlling the high pressure water zone. The well was drilled to 2610 m without serious problems, although multi-year ice encroached upon the drillsite several times. During an ice avoidance procedure after drilling out the 244 mm casing shoe, it was found that the "H-4" riser connector above the B.O.P.'s would not release. Consequently, a bridge plug was run and the complete B.O.P. stack was retrieved. The H-4 connector was repaired, the stack re-run and drilling proceeded to 3264 m.

Mechanical logs were run to 2600 m, however the remaining open hole portion was not logged. The quality of the intermediate logging was generally poor. Samples were collected every 10 metres from 200 m to total drilled depth. No sidewall cores were taken, and no zones were tested.

Ice conditions required suspension of the well on September 21st, approximately 150 m from the prospective horizon of the Kopanoar discovery. Albeit permission had been granted for the vessel to resume operations beyond September 25th, with stringent conditions, pending ice clearing at the site, the vessel was unable to re-enter the well and returned, on September 28th, to McKinley Bay for the winter. The Operator will re-enter the well in 1981 to drill to total depth and test the productive sands which are estimated at 3400 m.

6) Kenalooak J-94 (Figure 8)

The well was re-entered from Explorer III on August 12, 1980, having been drilled to 2132 m in 1979. Drilling proceeded to 3475 m and mechanical logs were run. The quality of the logs was generally poor to fair. A logging tool became stuck and seven days were spent on unsuccessful attempts to recover the instrument and to clear the hole for further drilling. It was decided to push the logging tool to the bottom of the open hole, run and cement casing and then side track the "fish" in further drilling. Coincidently, hazardous ice, only a few hours earlier thought to be benign, forced the drilling vessel to move from the location. In the course of that procedure, the drillpipe was hung off on the pipe rams, the riser disconnector activated and the guidelines sheared; however, the riser, still hanging in the moonpool area, was damaged when it became entangled with an anchor wire. After waiting on ice and repairing the riser, the well was re-entered some four days later. The intermediate casing was landed and cemented and the well successfully suspended on September 8th. The well will be re-entered in 1981 for drilling to total depth and testing.

7) Orvilruk O-03 (Figure 9)

The well was spudded from Explorer IV on July 7, 1980. Tight hole conditions were encountered in most of the hole to the setting of the surface casing at 2045 m. Drilling continued to 2992 m where a 5 m^3 gas kick was circulated out. (Some time later, in an unrelated incident, gas, probably originating from decomposing hydrates, was detected bubbling around the wellhead but terminated shortly thereafter). Overpressures dictated the running of the intermediate casing at 3018 m, some 300 m above the designed casing depth.

Mechanical logs were run to 3030 m, however the remaining open hole was not logged. The quality of the logs was generally poor to fair. Seventy-nine sidewall cores were attempted with fifty-eight recovered.

High pressure shales and consequently slow drilling penetration continued in the final section of the hole. However, an increased drilling rate was achieved by using a turbo-drill at 3500 m. Worsening ice conditions on September 7th forced Explorer IV to terminate drilling at 3606 m. The drillpipe was hung-off, the well was shut-in by closing the blind rams in the B.O.P. and the drillship departed the location. Continuing adverse conditions prevented re-entry of the well and on September 17th permission was granted to temporarily release the drillship from stand-by so that it could be taken to McKinley Bay for rudder repairs. Ice conditions at the wellsite, however, did not improve in late season sufficiently to permit the well to be re-entered and formally suspended. The well will be re-entered and tested in 1981.

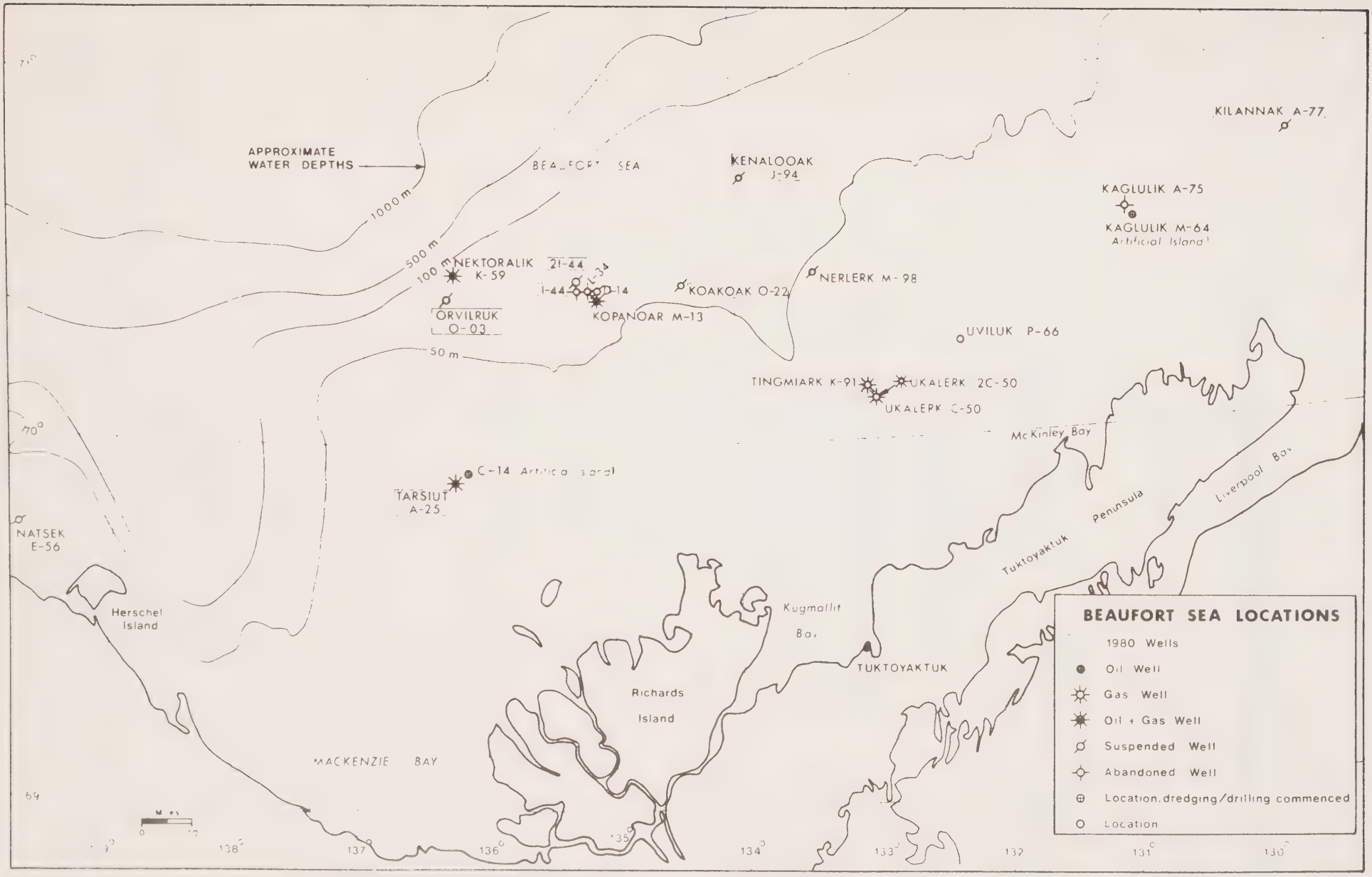
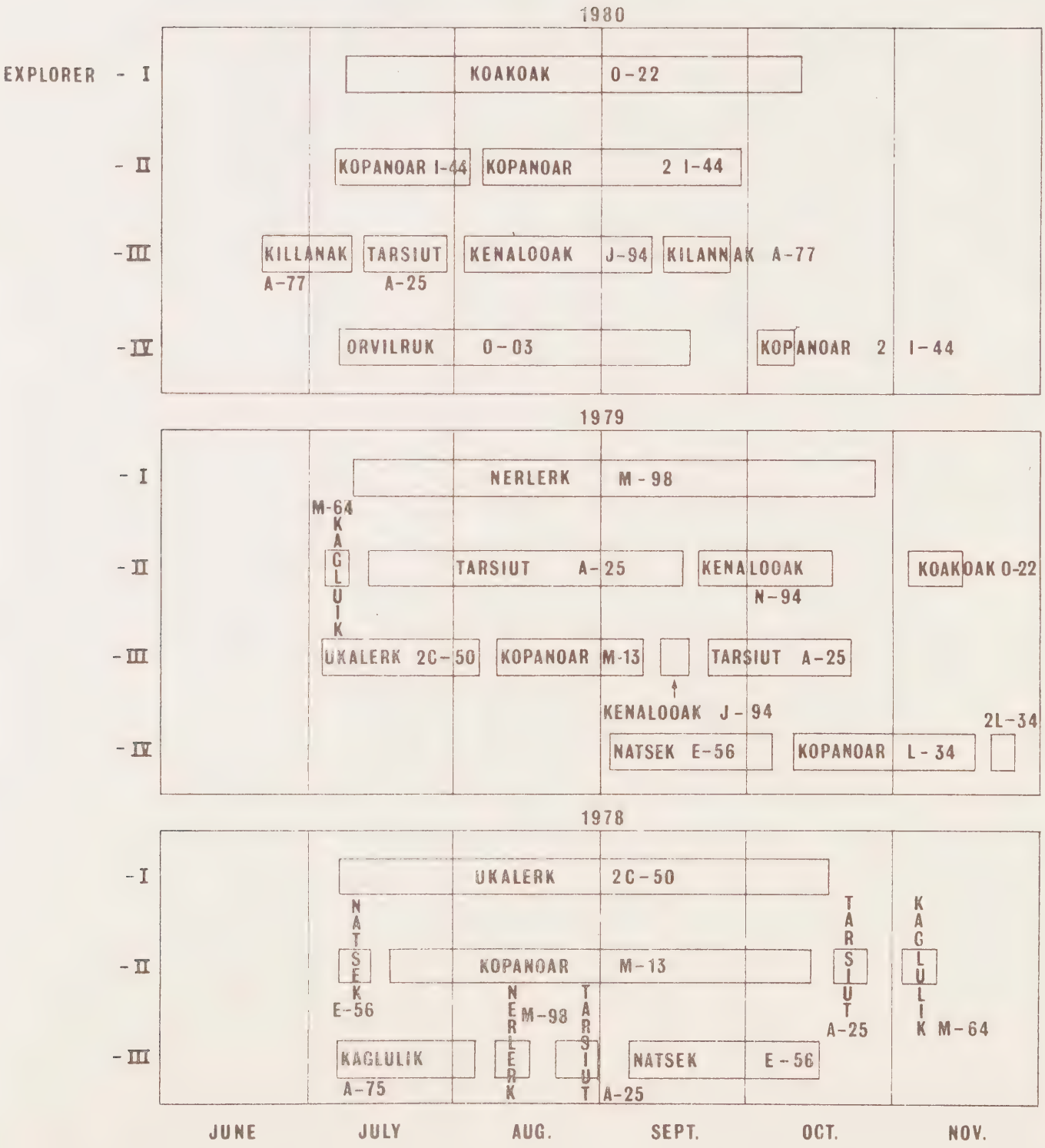
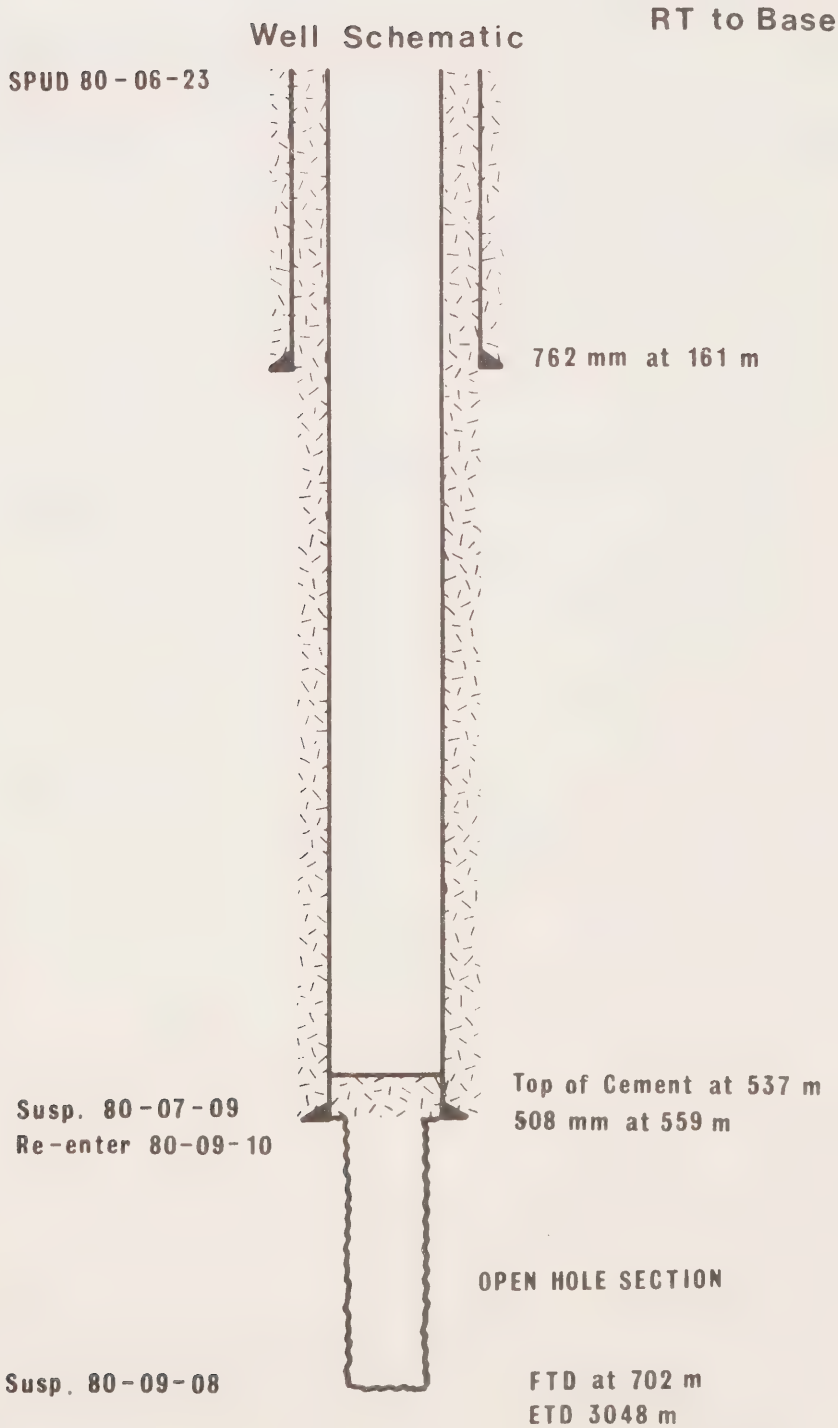

APPROXIMATE WATER DEPTHS
1000 m
500 m
100 m
50 m
BEAUFORT SEA
KENALOOAK J-94
KILANNAK A-77
KAGLULIK A-75
KAGLULIK M-64
Artificial Island
NEKTORALIK K-59
I-44
D-14
KOAKOAK O-22
NERLERK M-98
ORVILRUK O-03
KOPANOAR M-13
UVILUK P-66
TINGMIARK K-91
UKALERK 2C-50
UKALERK C-50
McKinley Bay
Liverpool Bay
Tuktoyaktuk Peninsula
C-14 Artificial Island
TARSIUT A-25
NATSEK E-56
Herschel Island
Kugmallit Bay
TUKTOYAKTUK
Richards Island
MACKENZIE BAY
70°
69
138°
137°
136°
135°
134°
133°
132
131°
130°
BEAUFORT SEA LOCATIONS
1980 Wells
Oil Well
Gas Well
Oil + Gas Well
Suspended Well
Abandoned Well
Location, dredging/drilling commenced
Location

Figure 1

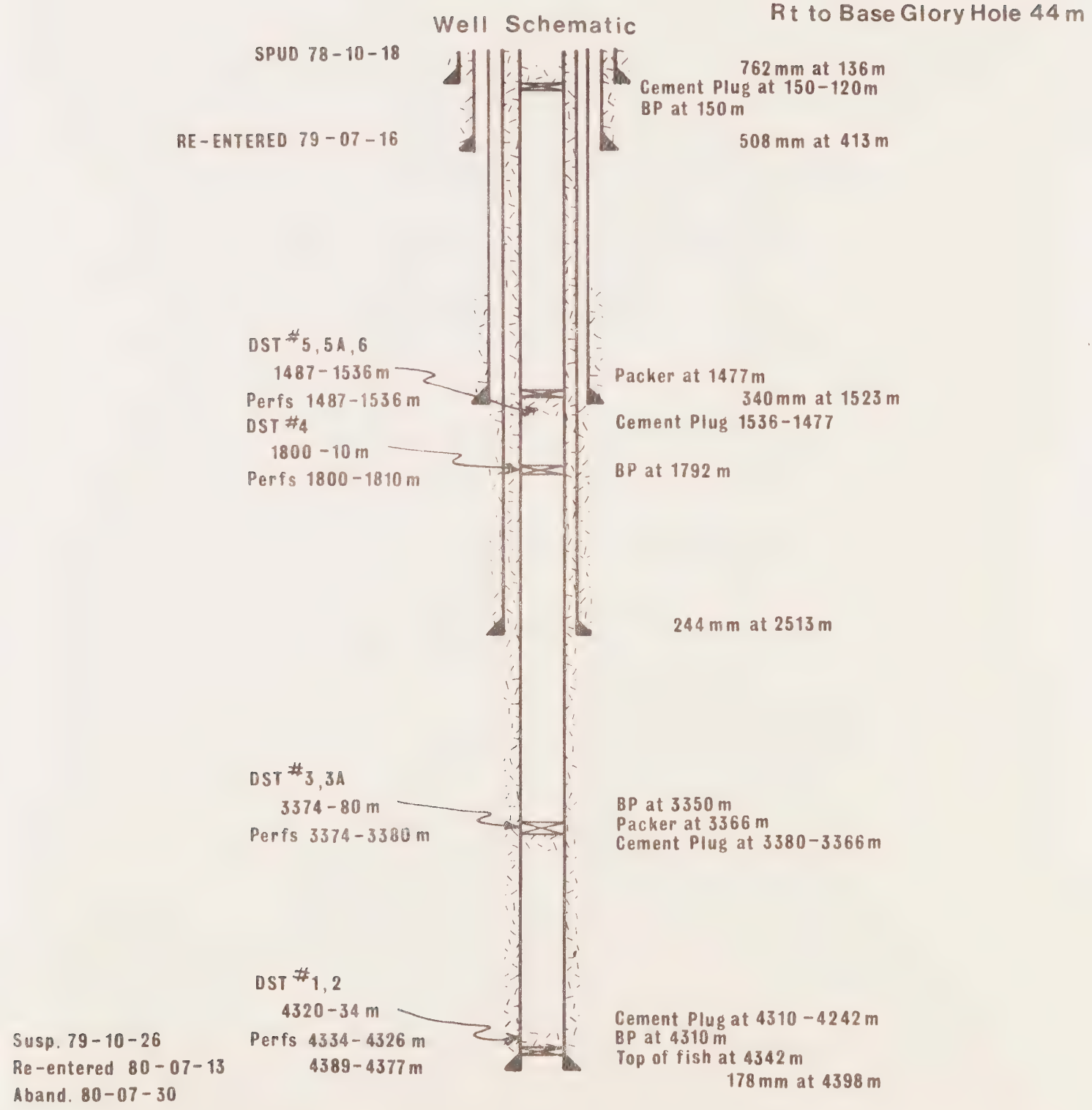
DEPLOYMENT OF CANMAR DRILLSHIPS 1978-80



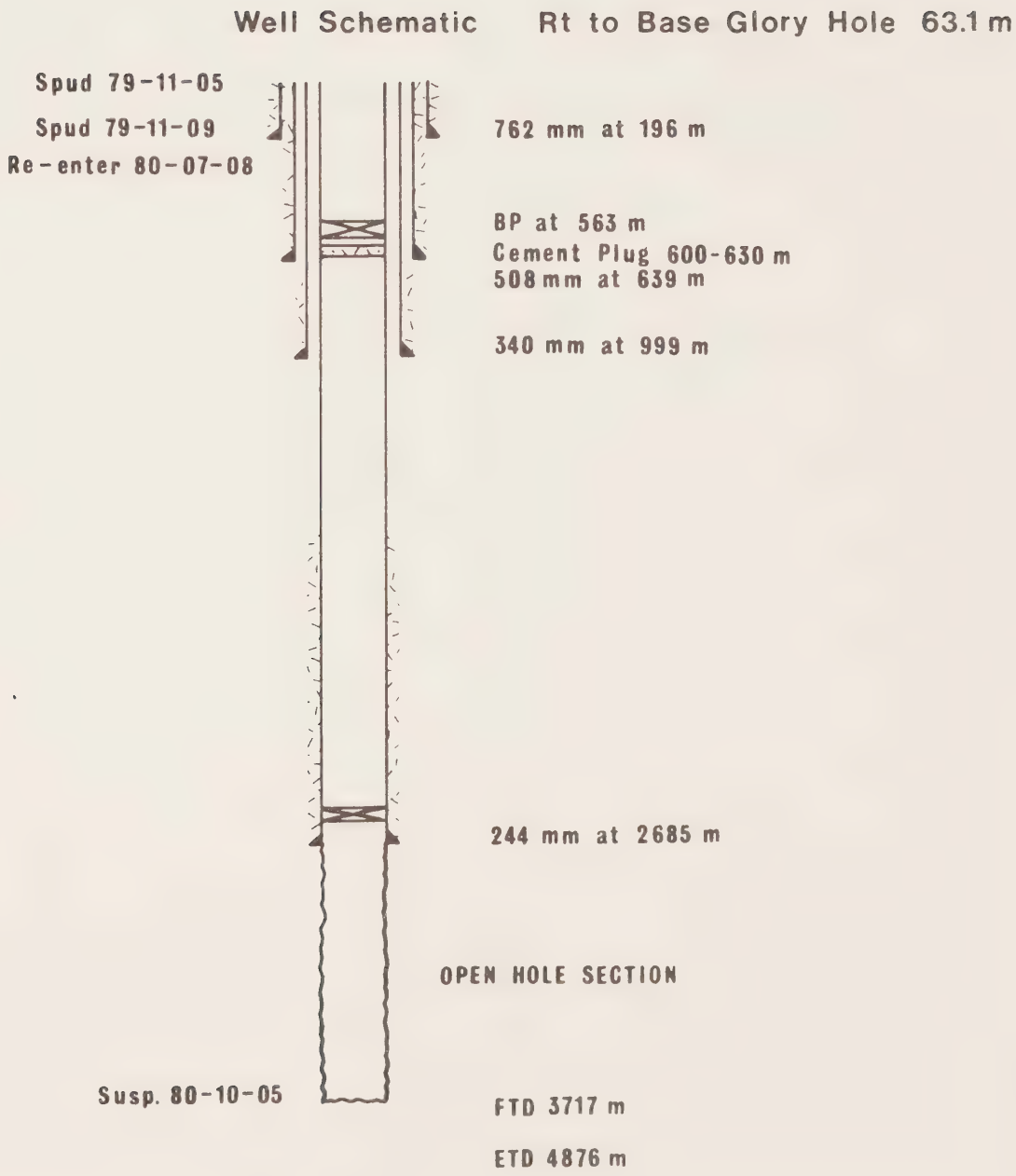
DOME et al KILANNAK
A-77
DA 966



DOME GULF TARSUIT
A-25
DA 910



DOME HUNT GULF KOAKOAK O-22
DA 946



DOME GULF HUNT KOPANOAR
I-44
DA 964

Well Schematic

Rt to Sea Floor 70.6 m

SPUD. 80-07-10

762 mm at 200 m

Perf. & Squeezed at 476 m
Cement plug at 466-476 m

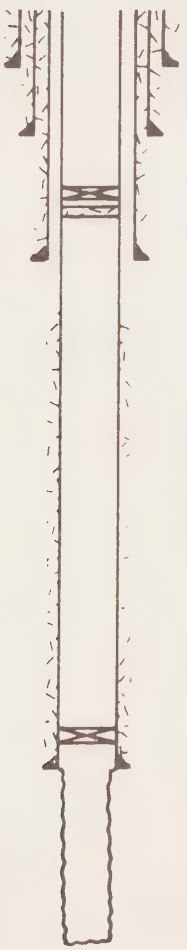
Cement plug at 535-545 m

Aband. 80-12-31

508 mm at 643 m
(Shoe not drilled out)

DOME GULF HUNT KOPANOAR 21-44
DA 967

Well Schematic Rt to Sea Floor 67.5 m



Spud 80-08-02

762 mm 188 m

508 mm at 422 m

Retainer at 634 m
Cement plug at 715-688 m

406 mm at 859 m

Retainer at 2490 m
244 mm at 2589 m

FTD at 3264 m

Susp. 80-09-21

ETD 4267 m

DOME HUNT KENALOOAK J-94
DA 909

Well Schematic

Rt to Sea Floor 82 m

Spud 79-09-14
Susp. 79-09-18
Re-spud 79-09-20

762 mm at 201 m

508 mm at 644 m
BP at 700 m

340 mm at 2132 m

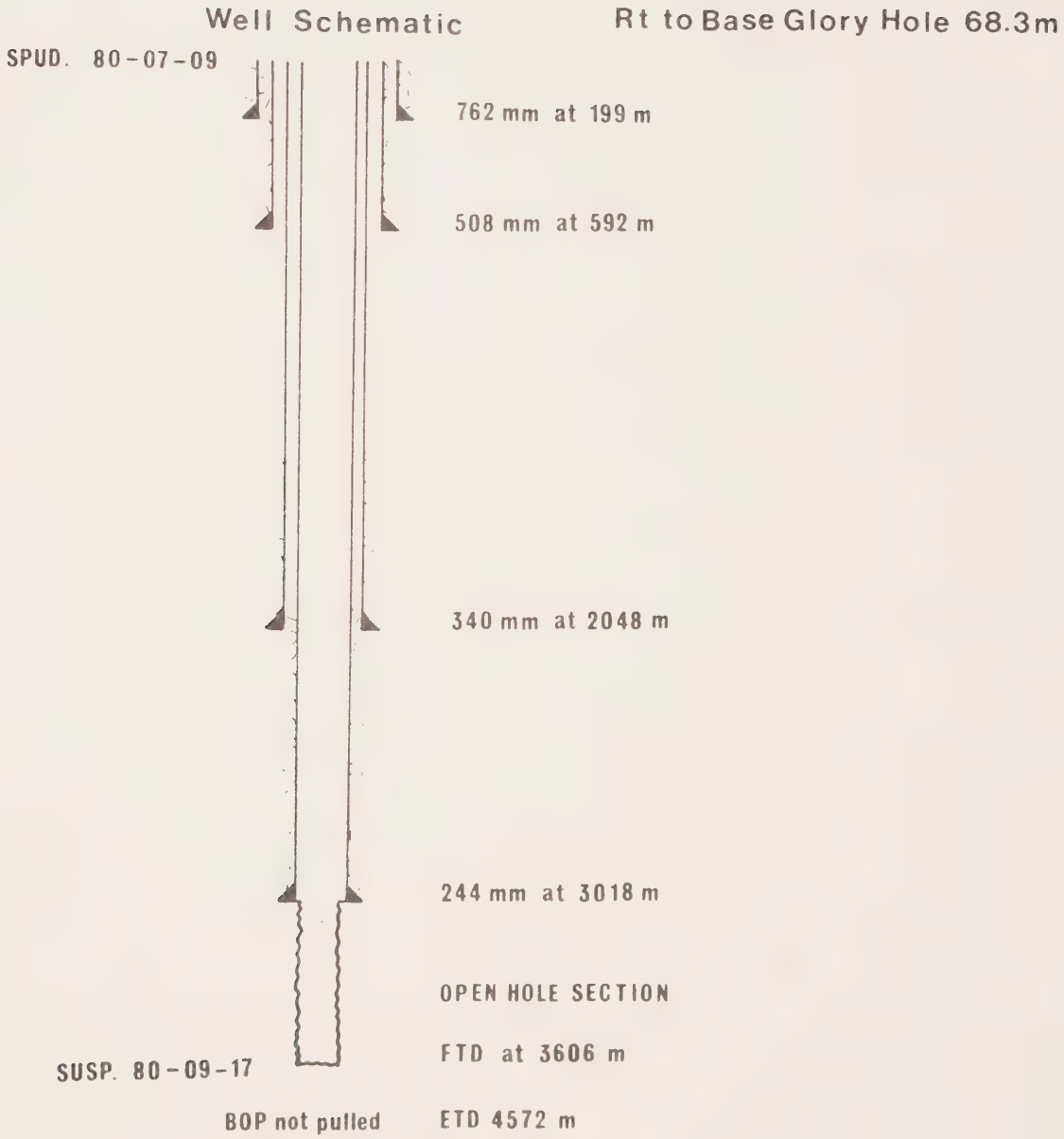
Susp. 79-10-22
Re-enter 80-08-05

Susp. 80-09-09

244 mm at 3345 m
(shoe not drilled out)

ETD 4877 m

DOME SUPERIOR ORVILRUK
O-03
DA 962



Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

REVIEW OF THE 1981 BEAUFORT SEA DRILLING PROGRAM

Northern Affairs Program

REVIEW OF THE 1981 BEAUFORT SEA DRILLING PROGRAM

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OBJECT

1. As directed by Cabinet in May 1976, and confirmed by Cabinet in Spring 1981, Dome Petroleum Ltd.'s Beaufort Sea Drilling program conducted by Canadian Marine Drilling Co. (Canmar) (Appendix 1 - Map No. 2) has been subjected to an annual comprehensive review. This report informs Cabinet of the findings from a review of technical operations, marine management, environmental impact and social-economic-cultural matters of Dome/Canmar's 1981 operations in the region of the Beaufort.

BACKGROUND

2. In 1973, Cabinet approved-in-principle drilling in the Beaufort Sea from floating platforms (drillships) then being proposed by Gulf Oil Canada Ltd. and by Hunt International Petroleum Ltd.

3. In May 1974, the Minister of Indian Affairs and Northern Development (IAND), approved Dome Petroleum Ltd.'s initial drilling program to be undertaken through its wholly owned subsidiary, Canadian Marine Drilling Ltd. (Canmar) in mid-1976.

4. In April 1976, Cabinet approved the issuance of Drilling Authorities for the initial exploration wells (Kopanoar and Tingmiark) included in Dome/Canmar's 1976 drilling program. The 1976 approval required the officials of the relevant government departments to undertake a comprehensive review of the Dome/Canmar program in the winter of 76-77.

5. In May 1977, the Cabinet accepted the interdepartment review of the 1976 program, submitted by the Minister (IAND), and approved its public release. Concurrently with that action, Cabinet approval was given to exploration drilling in the Beaufort Sea for a three year period 1977-79 inclusive, subject to modified conditions for determining the length of the operating season and to the following provisions:

   (a) That an annual report be provided to Cabinet by the Minister on the previous year's drilling operations.

   (b) That the Minister develop, in co-operation with the operator and the Beaufort Sea Community Councils, social and economic operating conditions. In the event that the operator failed to comply with such terms and conditions, the Minister would be authorized to suspend drilling operations.

   (c) That the government accept as a matter of priority the principle of providing a same-season relief well capability for all offshore drilling in Arctic waters.

6. In May 1978, Cabinet accepted the Minister's report on the 1977 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1978 subject to the same conditions approved in 1977 with the following changes:

(a) the social-economic commitments with respect to the northern elements of the Dome/Canmar Drilling program would be agreed to between the Company, and the Government of Canada by means of a Memorandum of Understanding in lieu of the formal agreement adopted in 1977;

(b) the start of drilling operations would be authorized by the Minister as early as, in the joint judgement of the shipmasters of Dome/Canmar's vessels, ice conditions at overwintering harbour, marine supply routes and well-site could safely permit;

(c) the definition of "deep" and "shallow" wells would be governed by site specific data on each well as to the threshold depth of potential hazard of blowout, that is the threshold depth for each well above which no oil or significant amounts of gas are anticipated;

(d) with respect to shutdown in 1978, "deep" wells would be terminated seven days prior to the forecast closure of Beaufort Sea operations, based on predicted weather and ice conditions, or by midnight September 25th whichever is earlier; and in respect of special circumstances, an extension of up to 10 days would be allowed for drilling and/or other operations in any deep well;

(e) for 1978, drilling and setting casing in "shallow" wells be permitted after September 25 but terminate 48 hours prior to midnight, December 5. At least one Arctic Class 2 supply boat would be committed to an operating drillship up to the formation of grey-white ice and thereafter at least two Arctic Class 2 supply boats;

(f) The Department of Transport would have available on a standby basis in the eastern Arctic during late September 1978 and 1979, a near Arctic Class 4 icebreaker to assist, if required, in relief well drilling in the Beaufort Sea;

(g) with respect to shutdown of drilling "deep" wells in 1980 and future years, the government would make no decision pending review at the appropriate time of the demonstrated capabilities of the drilling systems and of contingency measures under conditions of worsening ice and increasing darkness late in the 1978 and 1979 seasons;

(h) the navigation/operation of Canmar's drilling fleet in the Beaufort Sea (zone 12) be permitted irrespective of full capacity load of fuel oil on board, and that the Arctic Shipping Pollution Prevention Regulations be so amended to incorporate the appropriate navigation time provisions to accommodate the Canmar fleet and any other ship of the same class.

7. In May, 1979, Cabinet accepted the Minister's report on the 1978 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1979, subject to the same conditions established for the 1978 season, with the following changes:

(a) with respect to start-up in 1979, operations could commence as early as June 10;

(b) with respect to end of season shutdown of "deep" wells, an extension of up to 20 days could be allowed by the Minister or his designated official, for drilling and/or other operations;

(c) drilling and setting casing in "shallow" wells would be permitted until December 31 provided that the drillship were accompanied by two Arctic Class 2 vessels, and in addition one Arctic Class 3 vessel after December 5.

8. In May, 1980, Cabinet accepted the Minister's report on the 1979 drilling season, and approved further exploratory drilling in the Beaufort Sea in 1980, subject to the same conditions established for the 1979 season, with the following changes:

(a) the starting of drilling operations in "shallow" wells could be authorized by the Minister as early as practical in the Spring, but not before May 1st and should terminate by December 31;

(b) "deep" well operations could be undertaken as early as June 10, and should terminate by midnight, September 25. An extension of up to 20 days may be allowed by the Minister of IAND or his designated official, in consultation with the Minister of the Environment and the Minister of Energy, Mines and Resources, or their designated officials, for drilling and other operations in open hole;

(c) a drillship operating at a well-site should be accompanied by at least one Class 2 vessel before July 1st and after September 25 when ice is present; by at least two Class 2 vessels before June 15 and after the formation of grey-white ice; and by at least two Class 2 vessels and Class 3 vessel before June 10 and after December 5;

(d) the Minister indicated to Dome/Canmar the importance of increased Research and Development efforts by the Company in improving the efficiency of its oil spill containment and clean-up capability in the Beaufort;

(e) cabinet's annual review and approval of Dome/Canmar's operations in the Beaufort Sea should be maintained.

9. In April 1981, Cabinet accepted the Minister's report on the 1980 drilling season and approved further exploratory drilling in the Beaufort Sea in 1981 subject to the same conditions established for the 1980 season. Included in these operations were floating drilling operations from four Canmar drillships, one of which was operated by Gulf Resources Canada Ltd. and the other three by Dome, and artificial island construction by Canmar for well drilling operations to be carried out by Gulf.

10. The Beaufort Sea region extends northward from the Mackenzie River Delta and the adjacent coasts of the Northwest Territories and the Yukon Territory to the edge of the Continental Shelf (water depth approximately 185 metres). The region is under-lain by a wedge of deltaic sands and shales (Mezosoic and Tertiary ages) rapidly thickening seaward from the present Mackenzie Delta to more than 15,000 metres. The younger (Tertiary) sedimentary sequences contain many sandstones which are potential reservoirs. The oil and gas accumulations encountered at Kopanoar, Tarsiut, Koakoak and others occur in this sequence (See Discoveries - Appendix I - Map No. 1). A large number of geological structures indicating the potential accumulations have been identified in the region.

11. The Geological Survey of Canada, estimated in its Potential Hydrocarbon resources study, the region would yield 3.2 x $10^{12}m^3$(112 tcf) of gas and 1.5 x 10^9m^3(9.4 billion) of oil. Based upon the occurrence of oil and gas encountered by drilling in identified structures, the National Energy Board, in 1981, assigned a total of 150 x 10^9m^3(5.3 tcf) of established gas reserves to the Beaufort Sea Region, but did not recognize any established crude oil reserves.

12. The first oil and gas exploration wells were drilled in the 1960's and by 1981 a total of 143 wells were drilled (See Appendix I - Map No. 2). Exploration drilling advanced progressively from the on-shore in the late 60's into the near offshore in the early 70's and to date 20 wells have been drilled from artificial islands. In 1981, drilling from caisson retained artificial islands commenced with the initial unit being deployed at the Gulf et al E. Tarsiut location. Commencing in 1976, 21 wells have been commenced in the deeper waters by the 4 Dome/Canmar drillships, with 12 drilled to target depth, 6 abandoned at shallow depths for mechanical reasons, and 3 suspended for re-entry in future (1982) seasons.

13. Dome operates two shore bases in support of its Beaufort Sea drilling operation. These bases are located at Tuktoyaktuk east of the Mackenzie Delta and at McKinley Bay, on the western side of Tuk Penninsula some 90 km northeast of Tuktoyaktuk. As the principal administrative base, the Tuk facility provides hotel, office, storage and materials handling facilities for the Beaufort Sea Operation. The base provides accommodation for 344 people, dining facilities for 200 people, plus a recreation complex, laundry facilities, utility building, communication centre, and a fuel tank farm. A utilidor system provides the water and sewage services to the base.

    The McKinley Bay facility is the over-wintering facility for the drilling fleet. A 1.6 kilometre approach channel with a 10 metre draft has been dredged. A harbour has been dredged to accommodate the deep draft of the drillships (-10 metres) and dry-dock (-23 metres). The dredging spoils from these improvements have been used to create an ice protection island on the north side of the harbour. The surface of the island is now 63 hectares with 26 hectares in excess of 4 metres in elevation. The island has been brought to grade, leveled and compacted for storage areas. The harbour in 1981-82 accommodated 36 vessels of the drill fleet, 4 drillships, 4 dredgers, 3 crane barges, 2 floating camps, 2 tug boats, 9 barges and the dry dock.

FACTORS

14. The Beaufort Sea Steering Committee has again reviewed the technical operations, marine management, environmental impacts and social-economic-cultural matters of the 1981 operations. The Steering Committee was chaired by a senior official of IAND, with representation from the Departments of Energy, Mines and Resources; Transport; Industry, Trade and Commerce; Environment; Fishers and Oceans; External Affairs; the Canada Oil and Gas Lands Administration; and the Government of the Northwest Territories.

15. In 1981 Dome/Canmar operated a fleet of 43 vessels in the Beaufort Sea, 16 of which were associated with the drillship operation and the remaining 27 used in support of the island construction program (Appendix II). Dome utilized three ice-reinforced drillships (Canmar Explorers I, III and IV) and Gulf contracted Explorer II from Canmar.

16. The major artificial island dredging activity was undertaken at E. Tarsiut N-44 in 22 m water, the location of the construction of the first caisson-retained island in the Beaufort Sea. Concrete caissons, an innovative technique designed to minimize island construction time and cost, were fabricated in Vancouver, B.C. and barged around Alaska to the Beaufort Sea by late summer 1981. The Tarsiut island was constructed by building a submerged berm, to within 6 metres of the ocean surface using a

hopper-dredge, setting the four concrete caissons on top of the berm to form a large hollow square extending through the wave zone and then backfilling the core with dredged sand to form a drilling platform, with some 5 metres of freeboard. The experimental island is located in the transition zone between the polar pack and landfast ice and will be closely monitored for ice pressures, integrity of the berm, etc., that will predicate future similar projects. Gulf proposes to drill well(s) from this island over the 81-82 winter season. In addition, Canmar constructed artificial island berms at three locations namely Tarsiut, Uviluk and Kaglulik.

17. Extensive dredging was carried out at McKinley Bay harbour, including enlargement and deepening of the harbour and channel, dredging a dry-dock pit and providing enhanced breakwater protection for the winter mooring of the drillships. Major construction took place at the Tuktoyaktuk base improving the accommodation, yard and storage facilities. Future improvement of the shorebase and harbour is expected to maintain pace with the expansion of the exploration program though further growth of the Tuk base will be restricted at the request of Tuk Council.

18. Dome/Canmar's total expenditure for the 1981 Beaufort Sea operations was approximately $482 million. Of this amount, $313 million was spent on operating costs and $169 million on capital expenditures.

TECHNICAL SUMMARY

19. During the 1981 drilling season, drilling operations were conducted at the following seven wells (see Appendix III for comprehensive summaries and schematics of the well).

1) Dome Gulf Hunt Kopanoar 2I-44
2) Dome Hunt Gulf Koakoak O-22
3) Dome et al Kilannak A-77
4) Gulf et al Issungnak L-86
5) Dome Superior Orvilruk O-03
6) Dome Hunt Kenalooak J-94
7) Dome Hunt Irkaluk B-35

Excluded from this discussion are drillstem test data, geologic, geophysical and related confidential data, which, under legislation, are held confidential for two years after completion or abandonment of the well.

20. Season Commencement: Despite the relatively mild temperatures experienced during the winter of 1980-81 and the early appearance in 1981 of broad areas of open water west of Banks Island, ice floes covering much of the drilling areas had not cleared sufficiently for drilling operations to begin until mid-July. Explorer II was the first drillship to break out of the winter harbour on 81-06-21, however, ice conditions at the well-site were such that drilling operations could not commence at Issungnak L-86 until 81-07-18. The Kopanoar 2I-44 well was re-entered by Explorer I on 81-07-19. All four vessels were drilling by the last week in July.

21. Major Discoveries: Drilling took place at seven wells. Testing at Kopanoar 2I-44, a step-out 5 km west from the 1979 oil and gas discovery Kopanoar M-13, and Koakoak O-22, gave confirmation of major oil potential. Dome's engineering consultants, Degolyer and MacNaughton, reviewed the evaluation results and in a public statement indicated that "the potential hydrocarbon accumulation of oil in place is between 1.8 - 4.5 billion barrels at Kopanoar and 2 - 5 billion barrels in the Koakoak structure, with recoverable efficiencies ranging from 15 - 40 percent under existing engineering and operating techniques." Hence recoverable reserves may vary between $4.3 \times 10^7 m^3$ to $2.9 \times 10^8 m^3$ (0.27 to 1.8 billion barrels) at Kopanoar and $4.8 \times 10^7 m^3$ to $3.2 \times 10^8 m^3$ (0.3 to 2.0 billion barrels) at Koakoak. Dome has estimated that a threshold of "400 million barrels" is required for commercial production. (See Appendix I - Map No. 1).

22. Other Results: In addition to the discoveries at Kopanoar and Koakoak, promising structures at Orvilruk O-03, Irkaluk B-35 and Kenalooak J-94 still await drilling to total depth and testing in 1982. Gulf's Issungnak L-86 well had to be abandoned due to mechanical problems although gas shows were recorded in the lower section of the hole. Evaluation of electric-logs indicated that the primary reservoir was water saturated and the well was abandoned. The first dry hole that Dome has drilled in the Beaufort Sea was Kilannak A-77 which was abandoned in 1981.

23. Drilling Performance: The complex drilling conditions inherent in the Beaufort Basin were handled with knowledge and experience from five years of Beaufort Sea drilling. Shallow water sands at Irkaluk B-35 and gas kicks at Issungnak L-86 and Kopanoar 2I-44 were controlled by early identification and efficient procedures resulting in negligible lost time. Turbo drilling increased penetration rates, especially in the intermediate section of hole at Issungnak. The quality of the information obtained by the program was improved through the use of highly sophisticated

downhole logging tools and seismic profilers utilized to interpret lithologies. A dispersed lignosulphonate mud system was used to drill the Kilannak well, a system that is more stable than the KCL polymer mud system, making it easier to maintain the desired mud flow properties.

24. Drillship Performance: Despite the delay by heavy ice to the start of drilling operations, each drillship operated a higher average number of days, approximately 100, compared to 92 days in 1980. Problem down-time was also reduced over the previous year. The total hole drilled by Dome and Gulf in 1981 was 11 699 m, a significant accomplishment in light of the operational time spent drillstem testing. 12,943 m of hole were drilled in the 1980 season.

25. Mechanical Performance: In the main, the drilling and marine equipment performed satisfactorily during the 1981 season. Dome continues to modify and replace outmoded equipment with new and better units, such as cement tanks, shale shakers and mud cooling systems. Fairleads and spooling gear were also improved this year although some damage occurred to Explorer II during a late season storm and will be repaired over the winter. Mechanical hole problems were generally reduced in 1981, however, pressure testing of casings and cementing of liner overlaps did cause sufficient difficulties to warrant remedial measures. The number of sea and ice state occasions that precipitated releasing the drillship from the well location was less frequent than previous years and the hang-off, riser and anchor release systems performed adequately. The drillship ice breaking support and supply vessels performed more than adequately despite the increased workload demanded by island construction support activities at Tarsiut.

26. Safety Performance: The overall accident frequency rate (lost time accidents per 10^6 man hours worked) for Beaufort Sea Operations was 14.89, a significant drop from the 1980 rate of 22.50. Rates were down for drill systems, supply systems and support systems, while the dredging systems rate was up from last year perhaps attributable to an expansion in activity. A full-time safety supervisor was appointed for each of the systems.

27. Rescue Performance: Dome's search and rescue team was involved in two helicopter mishaps this summer. A Bell 212 helicopter deployed by Esso Resources Canada Ltd. went down during bad weather, appealed for assistance and in less than two hours the aircrew had been medivaced by Dome crews to Inuvik. The next day Dome's Sikorsky S-76 developed engine trouble and the pilots were rescued from the ice surface within minutes of the emergency call.

28. Ice Management Performance: Dome's ice management system, designed to detect and track ice floes in the vicinity of drillships in operation, gave early warning for the implementation of an Ice Alert System designed to stage-release the drillships away from hazardous encroaching ice. As in previous years, reconnaissance by helicopter, and fixed wing aircraft equipped with radar, aided ice observers in times of poor visibility. An innovation this year was a computerized shipborne ice alert monitoring system (SIAM), tied to Explorer IV, Tuk Base and an aircraft, which provided a useful tool for predicting ice movement for more efficient ice avoidance management.

    Another major accomplishment was the preliminary testing of the Radar Image Processing and Display (RIDS) system (on the drillship) which showed promise in enhancing the ice identification capabilities.

29. Season End: Although a limited amount of drilling time was lost due to interruptions from multi-year floes passing through the drill sites, generally the locations were clear until 81-10-13. Extensions beyond the deep drilling season limit of October 15 were granted for the testing through cased hole of Kopanoar 2I-44 and Koakoak O-22, ice conditions preventing further operations beyond 81-10-28 and 81-10-31 respectively. A shallow well was commenced at Irkaluk B-35 and ice infringement curtailed operations 81-10-22. As greater support at the end of the season was being given to the final stages of construction at the Tarsiut artificial island necessitating a contingency of support vessels including the Kigoriak Class III Icebreaker, three drillships were safely at winter mooring in McKinley Bay by the first week of November. Explorer IV was utilized as an accommodation ship for the Tarsiut construction crew until 81-11-18.

30. Surveillance: Inspectors from the Regional Office (Yellowknife) were assigned to administer the Canada Oil and Gas Drilling Regulations and to ensure compliance of conditions effected by issuance of the Drilling Program Approval by maintaining constant surveillance of Beaufort Sea operations. They were supported by officers in Yellowknife and Ottawa. Government surveillance, as in 1980, was performed on a rotational basis with one Inspector assigned to the drillships while another was in charge of the DIAND Oil and Gas office at Canmar's Tuk base. At more critical times, such as overseeing island construction activities at the Tarsiut island, monitoring was more concentrated and supported by officers from Headquarters, DIAND and the National Research Council. Deficiencies with respect to safety, good drilling practices or environmental concerns were noted and generally rectified promptly.

MARINE MANAGEMENT

31. Canadian Coast Guard Monitoring: DIAND requested the Canadian Coast Guard (CCG) to examine the strengths and weaknesses of the Dome fleet inclusive of the drillships and attending vessels; and to assess the capabilities of ship management in the operations and navigation modes under varying conditions of weather, sea and ice. The CCG, in carrying out its mandate under the provisions of the appropriate legislation conducted routine and special safety inspections of the Dome fleet; laid and carried out maintenance on various fixed and electronic aids to navigation; maintained pollution clean-up equipment and monitored pollution clean-up exercises.

32. Vessel Operations and Drillship Season Duration: The Arctic Shipping Pollution Prevention Regulations (ASPP) were amended as in 1980 to permit breakout and drilling by May 1. During the period of surveillance by CCG observers, no occurrences of unsafe practices were noted.

The early and late season ice management by the drill fleet depends heavily upon the Kigoriak remaining at full operating capacity. The concerns about the lack of backup to the Kigoriak will be eased by the arrival of Supplier 9, a new ice breaking support vessel, in 1982.

The Arctic Tuk and Arctic Breaker non-propelled barges were used to transport materials, equipment and oil to Tarsiut island. Towing, pushing, and combination of towing and pushing in level, rafted and ridged ice was not considered satisfactory. The pushing notches and fendering systems require increased attention to safeguard these operations.

Chartered Class Type E dredges were scheduled to cease operations by October 20 in order to comply with ASPP regulations. However, with the concurrence of the CCG observer, remedial dredging operations at Tarsiut by Geopotes X and the Hendrik-Zanen were terminated by October 27.

The Canmar Constructor barge was used for the construction of Tarsiut island and the accommodation hotel for island construction workers until ice conditions forced the substitution of Explore IV.

The introduction of the Canmar Careen floating drydock will permit all vessels including the drillships to be drydocked for inspection and repairs.

33. Ice Alert Procedures: The Procedures were further improved for the 1981 drilling season. It is mandatory to suspend a well if the number of support vessels on location does not meet the requirements of the ice alert. A doubling of the time factor to secure a well is now required. Information available from existing and new ice detection systems is gathered, centralized in Tuk base and disseminated to the drillships for direction regarding potential ice hazards. Other directions and procedures for communication are elaborated and improved. These procedures are based on practical experience and should form a basis for procedures for other operators who will be operating in the Beaufort Sea in the future.

34. Oil Spill Exercise: An Exercise was called from Tuk base on October 2. Ice Alert Procedures were invoked and the communication exercise concluded successfully.

35. Ice Reconnaissance: Daily fixed-wing ice-reconnaissance flights were undertaken lasting 3 hours covering a total of 530 km. Satellite reconnaissance obtained daily was adequate for regional coverage but limited for vessel navigation. SAR and SLAR flights conducted out of Inuvik provided for timely details of ice conditions over the intended vessel course. In addition, ship station observation by derrick top radar and the aforementioned SIAM system were utilized.

36. Weather: Environment Canada issued twice daily forecasts giving 24 hours synopsis augmented by hourly station observations resulting collectively in reliable predictions.

37. Communications: Radio communications were observed to be good. Ship Station Radio inspection certificates were found to be accurate and valid.

ENVIRONMENTAL SUMMARY

38. Environmental Operating Conditions: Dome/Canmar's and Gulf's operations were monitored once again by environmental inspections carried out by Pollution Prevention Officers of IAND and Department of Environment appointed under the Arctic Waters Pollution Prevention Act. Environmental conditions are established under this Act and are further defined as Environmental Operating Conditions attached to the comprehensive annual Drilling Program Approval and to the Drilling Authority specific for each well. The Arctic Waters Advisory Committee (Yellowknife) and the Interdepartmental Environmental Review Committee (Ottawa) endorsed the assessment of the extent to which Operators complied with these Conditions, and other non-drilling environmental matters under their surveillance, as presented in this Review.

39. Oilspills: A decrease in the number of oilspills associated with all facets of Dome's operations occurred in 1981. However, two oilspills of significance took place. The waste oil storage facility at Camp Farewell situated some distance from Tuktoyaktuk in the Mackenzie Delta reported a spill on May 23. A leaking value resulted in the loss of 775 m^3 of waste oil into the surrounding area. Clean-up procedures continued throughout the summer resulting in an estimated 95% recovery.

On August 30, a spill was reported involving a storage barge contracted to Dome and stationed in Tuk harbour. The barge was found partially submerged and leaking oil, investigation cited overloading and water entry through a damaged hatch as the probable causes of the spill. The barge was hauled onto the beach and a boom placed around the area to contain the spilled 16 m^3 of oil. Mop-up of the oil was performed using absorbent pads and skimmers and clean-up was completed by September 8.

40. Lease and Licences: A lease for the seabed for the enlarging of North Protection Island at McKinley Bay was issued to Dome under the Public Lands Grants Act. A further application by Dome to lease the seabed for the expansion of the mooring basin and entrance channel in McKinley Bay was returned to Dome to await policy decisions by IAND. A dredging license was issued to Dome to cover the dredging of the mooring basin. The material dredged was used to expand the north protection island.

41. McKinley Bay Monitoring: The Environmental Protection Service, Department of Environment, implemented a program for monitoring the impact of development on McKinley Bay and surrounding area. Sediment and benthos samples were collected to ascertain if there was any apparent increase in the presence of grease tar and oil purported to be visually evident in the area. A subsequent study undertaken by Arctic Lands Ltd. under contract to Dome concluded there was no increase of hydrocarbons in sediments from the mooring basin.

42. Disposal of Barite: A proposal by Dome to dispose of water contaminated barite at the north protection island was denied since it was considered that such products should be disposed of only in authorized sites.

43. Dredging at Herschel Island: A dredging licence was granted to dredge gravel deposits from a borrow source discovered to the southeast of Herschel Island. Dredging, for the purpose of providing erosion protection to the sand berm of the Tarsiut island, commenced in August and was completed October 18.

44. Artificial Islands Construction: Construction activity was concentrated on the Tarsiut N-44 location. The lease and dredging licenses with attached environmental conditions were issued to Gulf Canada Resources Ltd. in 1980. However, all construction at the site was carried out by Dome/Canmar and its contractors.

A lease and dredging licence were issued for 1981, in the construction of an artificial island at the Kaglulik location. It was commenced last year and, the island is about 30% complete. Approval was granted in February 1981 for construction of the sub-sea berm at Uviluk P-66 location and it is 65% completed.

45. Status of Tingmiark K-91 and Kopanoar D-14: Dome requested to be relieved of further monitoring at the Tingmiark and Kopanoar wells where shallow water flows have been experienced and observed in the past. This request was denied. No observations were reported by Dome for either well in 1981.

46. Oilspill Response Team Training Program: In addition to the regular training session held during the season under the auspices of DIAND, a special six-week off-season Basic Seamanship Course was held for all members of Canmar's Oil Spill Response Team. The course, half of which was held at "Tuk Tech", covered boat handling, steering, navigation, theory, safety and seamanship practices.

47. Compliance with Environmental Conditions: Dome, Canmar and Gulf's compliance with the requirements of environmental conditions relating to the drilling operations was considered adequate. Of concern were the use of unapproved drilling fluid products on four occasions throughout the season and problems encountered with the operation and maintenance of the oil/water separator units on the drillships to established effluent limits.

SOCIO-ECONOMIC-CULTURAL SUMMARY

48. Overview 1976-80: In June 1981, the GNWT issued an economic analysis of Dome/Canmar activities from 1976 to 1980 prepared by Outcrop Ltd., Yellowknife, N.W.T. It stated that over the years Canmar has provided 1,150 man-years of employment in the NWT at a total of $23.6 million in wages and salaries to NWT residents and has generated $28.5 million in northern value added to the NWT economy. From 1976-80 Canmar's total capital expenditure and operating costs have been $700 million. $73.5 million (10.5%) was expended in the NWT in direct employment of NWT residents, purchases of goods and services from local NWT companies or northern branches of companies with Headquarters outside the NWT. In addition, substantial progress by NWT Canmar employees into skilled and semi-skilled jobs has occurred. In 1976, 17% of NWT hires filled skilled or semi-skilled positions. By 1980 over 50% of NWT hires were in skilled or semi-skilled jobs.

49. Corporate Policy: The Company continued its program of northern employment and training, use of local services and business, support of social and cultural activities, and provision of information and communications.

50. Employment: The 1981 season proved to be Dome/Canmar's most successful in their Northern Employment program: more Northerners were employed, more skilled and semi-skilled positions were filled by Northerners, more stayed on the job over a longer period of time with more completing the season and earning end-of-season bonuses.

In 1981, 389 persons were hired to fill 243 positions compared to 338 hired to fill 194 positions in 1980. This represents an increase of 206% of persons hired from 1976 to 1981, and a 220% increase in positions over the same period of time. As in past years the greatest number of these employees came from Tuktoyaktuk and Inuvik (43%) followed by other Beaufort Sea communities (43%). Fourteen percent were recruited from outside the area.

"Turnover" rates for northerners remain high, and Dome will be asked to pay particular attention to this problem in 1982 with the objective of encouraging a more stable work force.

Over the past years Dome/Canmar's training programs, formal and training on-the-job, have provided an increased workforce of skilled and semi-skilled northerners. In 1976, 22 employees were classified as skilled or semi-skilled. By the 1981 season this number had increased by 827% to a total of 204 persons. The number of unskilled employees had steadily increased as well from 105 in 1976 to 185 in 1981. Between the 1980 and 1981 drilling seasons there was a 27% and 11% increase in the number of skilled and semi-skilled employess, respectively. The number of unskilled employees increased by 12% over the same period of time. Over 700 applications were processed by the Northern Employee Relations Office during 1981.

51. Wages: Earnings of northern employees of Dome/Canmar have continued to increase reflecting the increased skill levels and longer drilling seasons and periods of activity at the base camps. A 15% wage increase due to the cost of living alone has contributed to the substantial wage increase. In 1980, the average seasonal earnings were $10,355, increasing by 37% in 1981 to $14,139. The percentage increase in earnings from 1976 to 1981 is 349%.

52. Training: On-the-job training programs have continued to be the primary means of employee development. With the participation of the NWT Government and Canada Manpower, extensive training programs were conducted at Dome's Tuk base camp and Information Centre in office practices, heavy equipment operations and in basic seamanship. These courses were not restricted to current employees, but included other persons to provide them the opportunity to prepare for employment with Dome/Canmar or with others. Thirty-one of the 42 students enrolled in the Vocational Training School known as "Tuk Tech" successfully completed the course.

As well, Dome brought in a business education instructor from Calgary to conduct a seminar for their female employees in areas of money management, home management and job readiness.

To complement existing training programs i.e., training on-the-job, apprenticeships, etc., a successful off-season program has been implemented:

- 12 northern trainees attended the Petroleum Industrial Training School in Edmonton for a 4-week Pre-Employment roughneck course.

- 6 northern employees attended a 4-week Crane Operation course in Western Crane Services in Edmonton.

- 10 northern employees from the Beaufort Environmental Protection team participated in a 6-week training program including a 3-week basic seamanship course at Tuk base and a 3-week environmental protection course in Cowichan Bay, B.C., abroad the "North Star" vessel.

- 2 northern employees attended a 4-week dredging training program in Zwyinchecht, Holland in January 1981.

- Dome supported one apprentice electrician in his fourth and final year at S.A.I.T. in Calgary.

- Support was also given to an employee, a first mate who completed one of a two year program for Ocean Navigation Certification 1 at the Pacific Marine Training Centre in Vancouver.

Dome will however be asked to give greater attention to training in "apprenticable" skills.

53. Impact on Traditional Liefstyle: Offshore oil exploration appears to have had little negative impact on hunting and trapping activity during the past number of years in the Beaufort Sea communities.

Dome/Canmar has continued to take into consideration their Northern employee's desire to participate in renewable resource harvesting activity. Lay-offs tend to occur just prior to the opening of the hunting and trapping seasons and those who continue to work have been able to utilize time off and rotation schedules to participate in hunting and trapping.

54. Social Assistance: Social assistance for economic reasons in the Beaufort Sea communities decreased by 12% during the 1980 summer months from an average high of 43 cases per 1000 population during the winter months of 1979-80. The majority of child care cases occur during the summer months, resulting from less parental supervision and general boredom of the children.

In 1981, the company provided $98,622 in monetary donations to northern communities. Dome/Canmar continued its support of the Tuk Alcohol Education Program, Inuvik Alcohol Rehabilitation Centre and the Tuk Day Care Centre.

55. Impact on Local Communities: Dome/Canmar continued its "dry - camp policy" and supervised employee access to Tuktoyaktuk.

Since May, 1981, Dome Petroleum has been sponsoring the World Champion Cross-Country skiers, Sharon and Shirley Firth from Inuvik, N.W.T. The company has committed $40,000 to their ski training and competition endeavours in exchange for ski clinics and training programs which they will provide to local residents in the Beaufort/Delta communities.

Dome/Canmar also continued their supervisory pre-season orientation seminars for community members.

The Company provided support, material and financial assistance to a number of community and social organizations such as the Tuk Broadcasting Society; Tuk, Inuvik and Aklavik Councils; Northern Games; World Dog Racing Champion, Peter Norberg, and others.

OTHER CANADIAN BENEFITS

56. Impact on Canadian Economy: Major expenditures are made in Southern Canada with respect to expansion of the shore base facilities and complementation, and refitting of the Canmar's fleet of drilling, dredging and support vessels.

The following provides a detailed description of these expenditures and estimates as to their Canadian content.

CANADIAN CONTENT OF EXPENDITURES - 1981

	TOTAL $MM	CANADIAN %	CANADIAN $MM
Operating Expenses			
Personnel	82.6	100	82.6
Fuel	16.4	100	16.4
Catering	5.2	100	5.2
Professional Fees	14.0	93	13.0
Other Support Services	7.9	100	7.9
Maintenance & Supplies	17.7	97	17.1
Equipment	67.9	54	36.6
Caisson	22.0	100	22.0
Transportation & Freight	39.1	96	37.5
Well Servicing & Standby Expertise	5.6	99	5.5
Insurance	12.9	100	12.9
Well Consumables	14.7	79	11.6
Administrative	7.3	95	6.9
TOTAL OPERATING	313.3	88	275.2
Capital Additions Expenditures			
Drilling Equipment	21.2	62	13.1
Ship Modifications & Purchases	89.7	47	42.1
Base Expansion	25.2	95	23.9
Other Improvements	2.2	98	2.2
Ship Design	1.1	67	.7
Beaufort Sea Construct.	24.0	18	4.3
Beaufort Sea Prod. Dev.	4.0	80	3.2
Environmental Impact Statement	1.2	100	1.2
TOTAL CAPITAL ADDITIONS	168.5	54	90.7
TOTAL OPERATING AND CAPITAL ADDITIONS	481.8	76	365.9

It is apparent that a highly efficient build-up of Canadian expertise and equipment in offshore drilling is developing. Canadian resources are being developed by Canadian companies and the detection of hydrocarbons in the Beaufort Sea is encouraging this development to continue.

Using a multiplier of 3.0, the ripple effect on the Canadian economy from Dome/Camar's 1981 Beaufort Sea operations is estimated to be over one billion dollars.

FINANCIAL CONSIDERATIONS

57. Expenditures: For 1981 the total expenditures incurred to support the Canmar Beaufort Sea operations was $482 million. Of the total, approximately $366 million, or 76% of the total, was expended in Canada. Approximately 88% of the $313 million in operating expenditures was spent in Canada on Canadian goods and services. The total impact of this expenditure in Canada is estimated to result in excess of $825 million in Canadian income. Of the $168 million spent on capital expenditures, $91 million was spent in Canada creating an impact on the Canadian economy of $272 million. In summary, the total impact on the Canadian economy of these expenditures is estimated to amount to $1.1 billion.

58. Personnel: For periods of varying durations, Dome employed approximately 1265 individuals in the Beaufort operation. Of this total, all but approximately 103 individuals or 8% were Canadians. These individuals were specialized dredging personnel from Holland working on the Beaufort dredges the Aquarius, Geopotes X and the Hendrik Zanen. The total also includes people supplied by various contracting companies providing specialized services as required to support the various Beaufort activities. It is estimated that the total direct and indirect employment created by the various operations was in excess of 5300 man-years of employment, essentially all in Canada.

INTERNATIONAL ASPECTS

59. U.S.A.: United States authorities continued to follow closely the Canadian Beaufort Sea drilling operations in 1981 in keeping with their previously expressed concern regarding the potential for environmental impacts connected with Arctic offshore hydrocarbon development. A sixth round of consultations with the U.S. was held in June 1981. In addition to reviewing the past season, the meeting exchanged information regarding the environmental and socio-economic impacts of exploration and development, methods of regulation, systems of transportation that might be employed for the removal of hydrocarbons from the Arctic and the U.S. Program for exploration offshore Alaska.

FEDERAL-TERRITORIAL RELATIONS

60. GNWT-GYT: Senior officials of the Government of the Northwest Territories and the Yukon Territory have been kept apprised of the drilling program in the Beaufort Sea throughout the 1981 drilling season. The N.W.T. Government has membership on the Steering Committee formed by IAND to conduct the review of 1981 operations and chaired and staffed the sub-committee that monitored and reviewed the social-economic-cultural impact of the 1981 drilling program.

INTERDEPARTMENTAL CONSULTANTS

61. Steering Committee: IAND again created an intergovernmental, interdepartmental Steering Committee to conduct the 1981 Beaufort Sea drilling program review. Interested Departments participated in the review process and have been consulted with respect to this report.

PUBLIC INFORMATION

62. Community Liaison: The role of the Beaufort Sea Community Advisory Committee is to advise, evaluate, review and report on the company's activities as they affect the local population. Since early in 1976, Dome has promoted the liaison with the seven Beaufort Sea communities through the representative body of the BSCAC. The Committee has been instrumental in promoting northern employment and training, local business involvement and environmental protection. In 1981, the Beaufort Committee met with Dome Petroleum in Holman Island in January, Aklavik in April, Tuktoyaktuk in July, and Paulatuk in October. A special meeting of the Committee was held in Inuvik on August 27 with the Minister (IAND). The Committee presented their list of priorities for government attention in the Beaufort Sea region including vocational training schools, adult education upgrading in the communities and an adult vocational training centre in Tuktoyaktuk or Inuvik.

63. Government Liaison: Dome representatives met with Federal, Territorial, Regional and Local Governments on a regular basis. Government officials visited Dome's Beaufort Sea operations including federal Ministers of IAND, DEMR, DREE and DOE. Several GNWT Ministers and MLA's visited the operation, as well as the entire Yukon Assembly.

CONCLUSIONS

64. Test results of Kopanoar 2I-44, a step-out delineation well from the Kopanoar M-31 oil discovery well, and of Koakoak O-22, a new oil discovery, indicated high flow capacity and indicates the presence of large volumes of proved and probable oil reserves in the two structures.

65. The successful construction in one season of the caisson-retained island at Tarsiut was perhaps the most significant technological advancement made in 1981.

66. The main elements leading to lost drilling time in the 1981 season were environmental, waiting on ice in the early season and waiting on weather during the season.

67. The drilling supervisors and crews demonstrated their operational expertise in emergency hang-off procedures and in maintaining well control during gas influx to the well bore.

68. Dome's/Canmar's 1981 overall safety record shows a significant improvement over that of 1980, with the exception of Beaufort Sea construction, and probably reflects the enhanced accident prevention program and better training in all facets of northern offshore work.

69. Dome complied with the technical conditions of the Program Approval, Drilling Authority, and the Drilling Regulations during 1981 Drilling Season.

70. During the period of surveillance by Canadian Coast Guard observers no occurrences of unsafe marine practices were noted.

71. Almost all oil spilled this season was accumulated waste oil. The majority of this oil was spilled in two incidents, one at a remote tank farm and the other involving overloading of a fuel storage barge.

72. A significant decrease in the number of oil spills associated with all facets of Dome's operation occurred in 1981.

73. The increase in wastes generated by offshore exploration activity creates the need for suitable disposal sites.

74. Dome's overall compliance with the requirements of environmental conditions relating to drilling operations was considered adequate.

75. Dome, during the 1981 drilling season, abided by the Social, Economic and Cultural Policies set out by the Company to the satisfaction of GNWT and DIAND.

RECOMMENDATIONS RESULTING FROM THE TECHNICAL REVIEW

It is recommended that:

1. Pre-season on-the-job training of drilling crews on hang-off, kick control, and other operational procedures be maintained at a high standard to ensure the maximum degree of safety for personnel, equipment and the northern environment.

2. The procedures in the running and cementing and testing of liners and casing be examined by Dome's drilling engineering staff to reduce the incidence of remedial squeeze cementing.

3. All drilling engineers, supervisors and if possible, rig inspectors, receive formal instruction in the concept of kick tolerance and its application to practical well control in the Beaufort Sea.

4. The Diving Systems Engineer, COGLA should conduct a pre-season study session with divers and associated personnel and an inspection of all diving equipment on board, and make at least one more complete inspection tour about mid-point in the offshore drilling season.

RECOMMENDATIONS RESULTING FROM THE MARINE MANAGEMENT REVIEW

It is recommended that:

1. Amendments be made to the Arctic Shipping Pollution Prevention (ASPP) Regulations to permit attempts by the drilling fleet to breakout from winter harbours not earlier than May 1, 1982.

2. That the number of support ships required to attend a drillship during drilling operations after the formation of grey/white ice at the end of the 1982 season be the same as for 1981.

3. That the conditions for navigation of drillships and vessels at the end of the season be the same as for 1981.

4. Drillships not fitted with underwater mooring fairleads and bubbler systems (Canmar Explorer I, Canmar Explorer II and Canmar Explorer III) cease drilling operations regardless of the attending vessels when the accumulation of degree days of freezing reaches 265, that is at the time of formation of first year ice.

5. Drillships fitted with underwater mooring fairleads and bubbler systems (Canmar Explorer IV) cease drilling operations regardless of the vessels in attendance with the accumulation of degree days of freezing reaches 650, that is at the time when the ice thickness is approximately 9 cm.

6. The executive summary reports sent out from the drilling fleet after freeze up commences in late season include a statement of attending support vessels, their times of arrival and departure on station, state of effectiveness and all incidents, however temporary, which reduce that effectiveness.

7. DOME be requested to evaluate 1981 performance and introduce suitable modifications to ice transiting barges ARCTIC BREAKER and ARCTIC TUK if use in late season is part of an operational plan.

RECOMMENDATIONS RESULTING FROM THE ENVIRONMENTAL REVIEW

It is recommended that:

1. Increased surveillance be required at remote, large-capacity fuel storage facilities, particularly prior to and during open water periods and qualified marine personnel be required to inspect such vessels as floating fuel storage barges on a regular basis to ensure the vessels seaworthy.

2. A Government survey of potential waste disposal locations be undertaken with consideration given to the nature and quantities of wastes anticipated over long-term operations.

3. Additional environmental inspectors/inspections be required to ensure that the efforts made by Dome are not undermined by a lack of environmental consciousness on the part of other operators in multiple-use areas such as Tuktoyaktuk Harbour and McKinley Bay.

4. The oil/water separator effluent limit of 50 mg/l oil and grease content be reassessed in light of the technology available to the Operator to meet this limit and the data accumulated through monitoring and surveillance programs.

5. Dome report applicable spills to IAND's twenty-four (24) hour spill report line utilizing the established "Government of the Northwest Territories Spill Report" form. Personnel listed on the twenty-four (24) hour spill report line "Government Agency Contact" should ensure that knowledgeable persons are designated in their absence to assume prescribed responsibilities in the event of a spill.

6. All personnel especially crews of chartered foreign vessels be made aware of the responsibilities and procedures required in the event of an oil spill when operating in Canadian waters.

7. The environmental inspection program carried out by Pollution Prevention Officers to monitor offshore drilling activities in 1981 be repeated in 1982.

8. Environmental Conditions for Drilling Program Approval and Drilling Authorities be issued to Dome in 1982 to ensure that all environmental concerns related to offshore exploratory drilling are adequately addressed.

RECOMMENDATIONS RESULTING FROM THE SOCIAL-ECONOMIC-CULTURAL SUMMARY

It is recommended that:

1. Company intake be increased at all levels particularly at the unskilled level to assure a satisfactory number of northerners moving into the semi-skilled and skilled categories in the future through additional training and an expansion of the recruitment area in the N.W.T.

2. The "Tuk Tech" concept be maintained to ensure more northerners access to skill training.

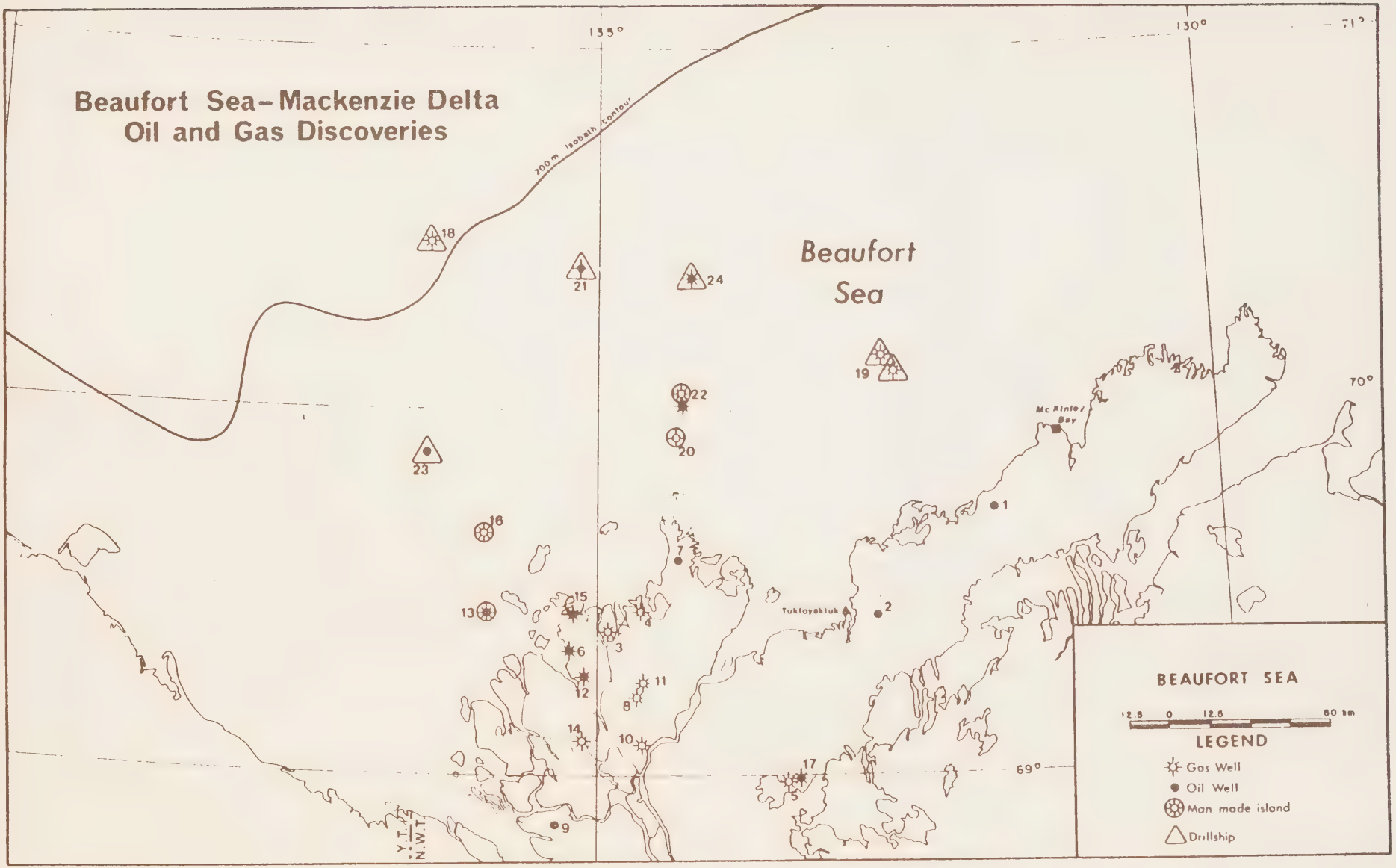
3. The company and the GNWT, Department of Economic Development and Tourism, review company manpower needs in terms of increasing the number of indentured apprentices in the Beaufort Sea operation.

4. The company address the problem of instability in the Northern workforce by establishing opportunities tailored for long term needs and aspirations of local people.

APPENDIX I

MAP No. 1 OIL AND GAS DISCOVERIES, BEAUFORT SEA-MACKENZIE DELTA

MAP No. 2 DRILLING OPERATIONS, BEAUFORT SEA 1973-81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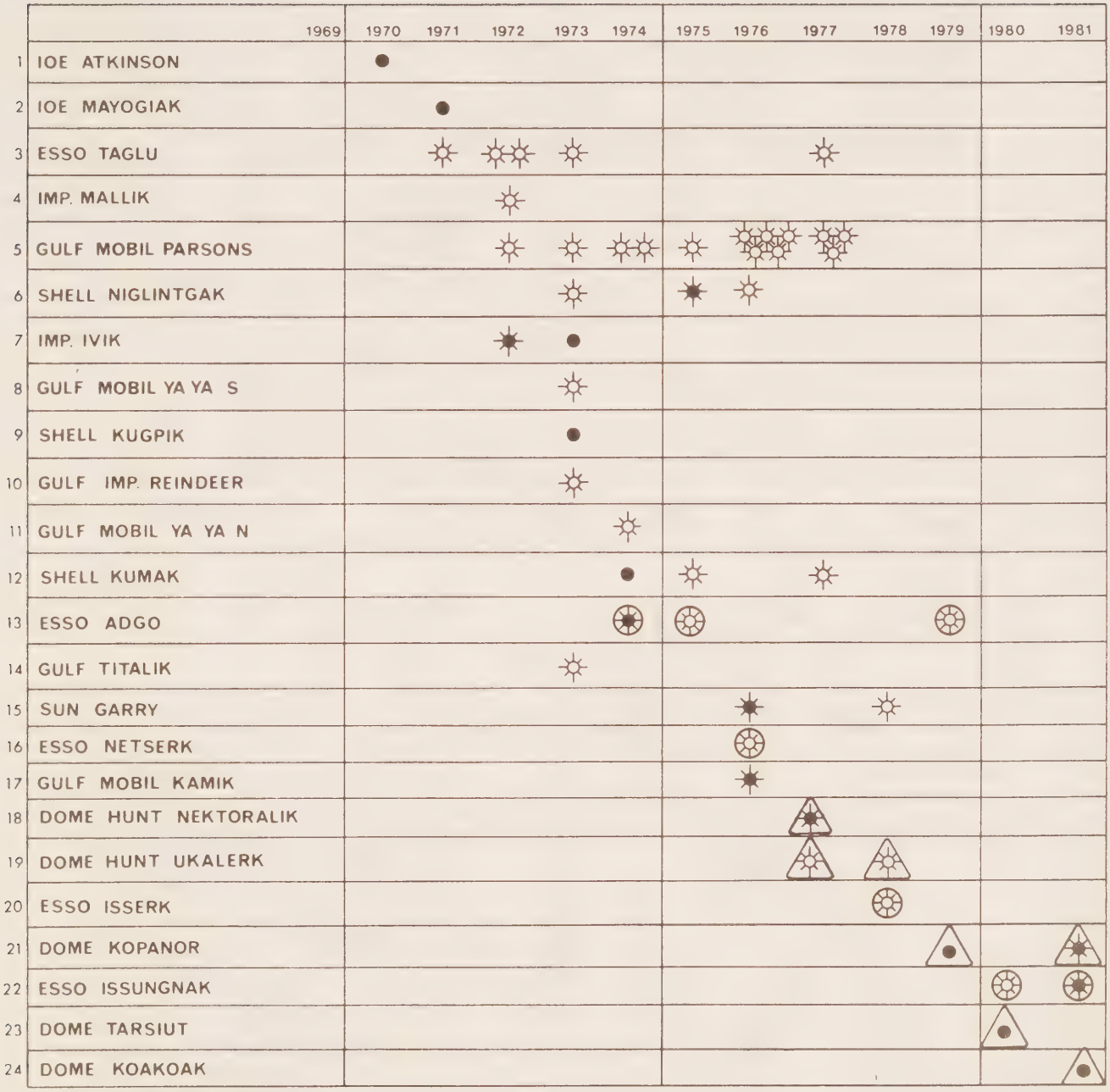
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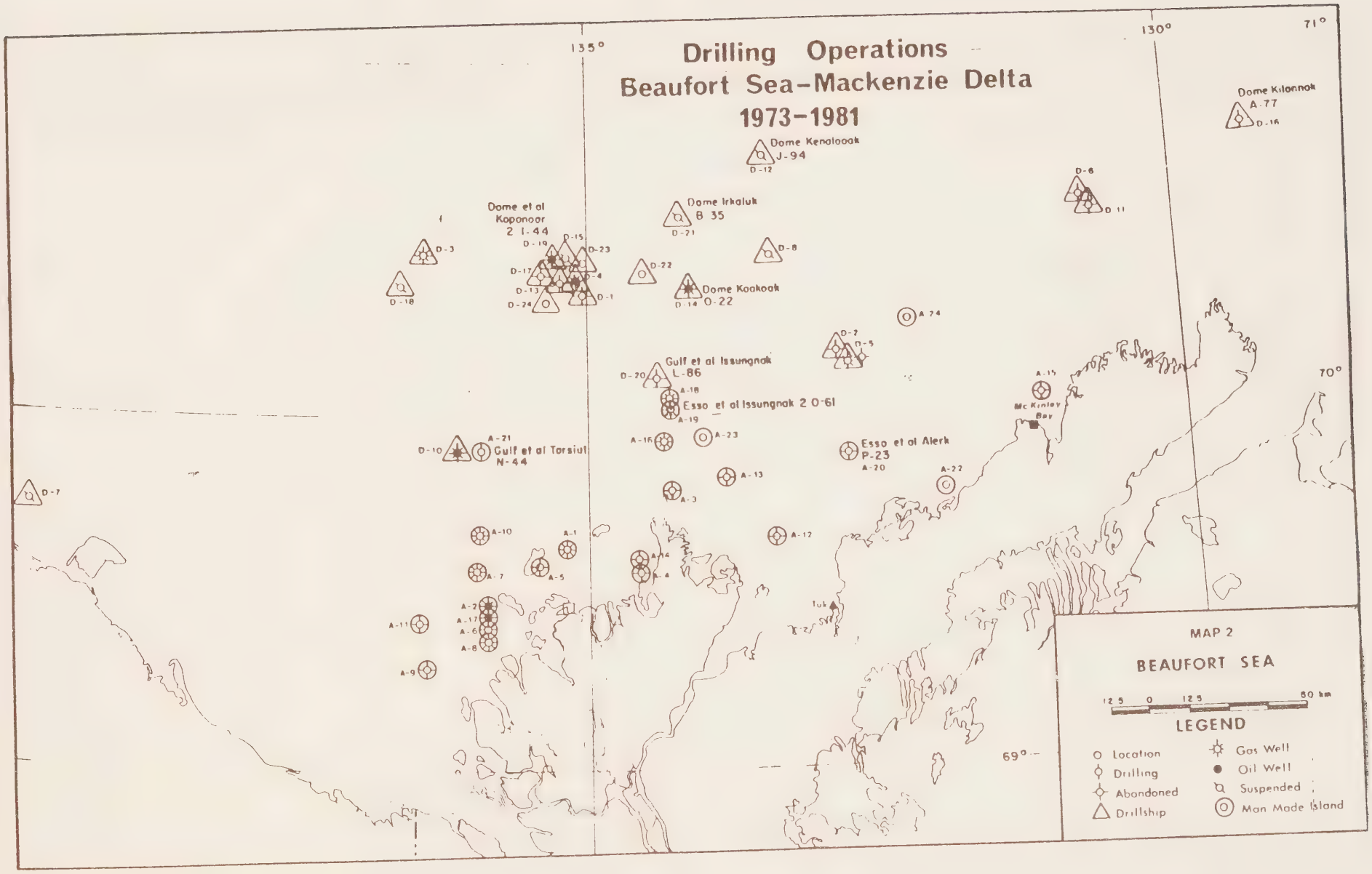
5 GULF MOBIL PARSONS
6 SHELL NIGLINTGAK
7 IMP. IVIK
8 GULF MOBIL YA YA S
9 SHELL KUGPIK
10 GULF IMP. REINDEER
11 GULF MOBIL YA YA N
12 SHELL KUMAK
13 ESSO ADGO
14 GULF TITALIK
15 SUN GARRY
16 ESSO NETSERK
17 GULF MOBIL KAMIK
18 DOME HUNT NEKTORALIK
19 DOME HUNT UKALERK
20 ESSO ISSERK
21 DOME KOPANOR
22 ESSO ISSUNGNAK
23 DOME TARSIUT
24 DOME KOAKOAK


Drilling Operations
Beaufort Sea–Mackenzie Delta
1973–1981
135°
130°
71°
70°
69°
Dome Kenalooak
J-94
D-12
Dome Kilannak
A-77
D-16
D-6
D-11
Dome et al
Koponoor
2 I-44
Dome Irkaluk
B 35
D-21
D-3
D-19
D-15
D-23
D-17
D-4
D-22
D-8
D-18
D-13
D-24
D-1
Dome Kaakaak
D-14
O-22
A-74
D-7
D-5
Gulf et al Issungnak
L-86
D-20
A-18
Esso et al Issungnak 2 O-61
A-19
A-15
Mc Kinley Bay
D-10
A-21
Gulf et al Tarsiut
N-44
A-16
A-23
Esso et al Alerk
P-23
A-20
A-22
D-7
A-13
A-3
A-10
A-1
A-12
A-7
A-5
A-14
A-4
A-2
A-17
A-6
A-11
A-8
A-9
Tuk
E-2
MAP 2
BEAUFORT SEA
12.5 0 12.5 80 km
LEGEND
Location
Drilling
Abandoned
Drillship
Gas Well
Oil Well
Suspended
Man Made Island

Artificial Island Wells

Year	No.	Name	Depth	Status
1973	A-1	Imp Immerk B-48	2,708	Gas Discovery
1974	A-2	Esso Adgo F-28	3,209	Oil & Gas Disc.
	A-3	Imp Pullen E-17	3,885	D&A
1975	A-4	Sun et al Unark L-24	3,813	D&A
	A-5	Sun et al Pelly B-35	3,328	D&A
	A-6	Esso Adgo P-25	2,538	Oil & Gas Disc.
	A-7	Imp Netserk B-44	3,528	Gas Discovery
	A-8	Imp Adgo C-15	3,193	Oil & Gas Disc
1976	A-9	Imp et al Ikattok J-17	3,810	D&A
	A-10	Esso Netserk F-40	4,370	Gas Discovery
	A-11	Imp Sarpik B-35	3,291	D&A
	A-12	Imp Kugmallit H-59	2,193	D&A
1977	A-13	Imp Arnak L-30	4,523	D&A
	A-14	Sun et al Unark A L-24	3,935	D&A
	A-15	Imp Kannerk G-42	2,481	D&A
1978	A-16	Esso et al Isserk E-27	4,056	Gas Discovery
1979	A-17	Esso Adgo J-27	3,110	Oil & Gas Disc.
1980	A-18	Esso Issungnak O-61	3,583	Oil & Gas Disc.
1981	A-19	Esso et al Issungnak 2 O-61	4,460	Oil & Gas. Disc.
	A-20	Esso et al Alerk P-23	3,223	D&A
1982	A-21	Gulf et al E. Tarsiut N-44	3,810	Drilling
	A-22	Esso W. Atkinson L-17		
	A-23	Esso Itivok M-17		
	A-24	Dome et al Uviluk P-66		

Drillship Wells

Year	No.	Name	Depth	Status
1976	D-1	Hunt et al Kopanoar D-14	1,146	D&A
	D-2	Dome et al Tingmiark K-91	3,051	D&A
	D-4	Dome et al Kopanoar M-13	485	SUSP
	D-3	Dome et al Nektoralik K-59		
1977	D-3	Dome et al Nektoralik K-59	2,791	Oil & Gas Disc.
	D-4	Dome et al Kopanoar M-13	2,793	SUSP
	D-5	Dome et al Ukalerk C-50	2,306	D&A
	D-6	Dome Kaglulik A-75	412	SUSP
	D-7	Dome et al Natsek E-56		
	D-8	Dome Nerlerk M-98	549	SUSP
1978	D-4	Dome et al Kopanoar M-13	4,320	SUSP
	D-6	Dome Kaglulik A-75	645	D&A
	D-7	Dome et al Natsek E-56	2,687	SUSP
	D-8	Dome Nerlerk M-98	549	SUSP
	D-9	Dome et al Ukalerk 2 C-50	4,953	D&A
	D-10	Dome et al Tarsiut A-25	435	SUSP
	D-11	Dome Kaglulik M-64	144	D&A
1979	D-4	Dome et al Kopanoar M-13	4,320	Oil Discovery
	D-7	Dome et al Natsek E-56	3,520	SUSP
	D-8	Dome Nerlerk M-98	4,939	SUSP
	D-9	Dome et al Ukalerk 2 C-50	4,953	Gas Discovery
	D-10	Dome et al Tarsiut A-25	4,434	SUSP
	D-11	Dome Kaglulik M-64	144	D&A
	D-12	Dome Kenalooak J-94	2,150	SUSP
	D-13	Dome et al Kopanoar L-34	2,015	J&A
	D-14	Dome Koakoak O-22	210	SUSP
	D-15	Dome et al Kopanoar 2 L-34	181	SUSP
1980	D-10	Dome et al Tarsiut A-25	4,434	Oil & Gas Disc.
	D-12	Dome Kenalooak J-94	3,475	SUSP
	D-14	Dome Koakoak O-22	3,717	SUSP
	D-16	Dome et al Kilannak A-77	702	SUSP
	D-17	Dome et al Kopanoar I-44	649	J&A
	D-18	Dome et al Orvilruk O-03	3,606	SUSP
	D-19	Dome et al Kopanoar 2 I-44	3,164	SUSP
1981	D-12	Dome Kenalooak J-94	3,475	SUSP
	D-14	Dome Koakoak O-22	4,365	Oil & Gas Disc.
	D-16	Dome et al Kilannak A-77	2,996	D&A
	D-18	Dome et al Orvilruk O-03	3,606	SUSP
	D-19	Dome et al Kopanoar 2 I-44	4,010	Oil & Gas Disc.
	D-20	Gulf et al N. Issungnak L-86	4,771	D&A
	D-21	Dome et al Irkaluk B-35	2,211	SUSP
1982	D-8	Dome Nerlerk M-98	4,939	
	D-12	Dome Kenalooak J-94	3,475	
	D-18	Dome et al Orvilruk O-03		
	D-21	Dome et al Irkaluk B-35	2,211	
	D-22	Dome et al Siulik C-07		
	D-23	Dome et al Kopanoar		
	D-24	Dome et al Arluk P-80		

Artificial Island Wells

Year	No.	Name	Depth	Status
1973	A-1	Imp Immerk B-48	2,708	Gas Discovery
1974	A-2	Esso Adgo F-28	3,209	Oil & Gas Disc.
	A-3	Imp Pullen E-17	3,885	D&A
1975	A-4	Sun et al Unark L-24	3,913	D&A
	A-5	Sun et al Pelly B-35	3,323	D&A
	A-6	Esso Adgo P-25	2,538	Oil & Gas Disc.
	A-7	Imp Netserk B-44	3,528	Gas Discovery
	A-8	Imp Adgo C-15	3,193	Oil & Gas Disc
1976	A-9	Imp et al Ikattok J-17	3,910	D&A
	A-10	Esso Netserk F-40	4,370	Gas Discovery
	A-11	Imp Sarpik B-35	3,291	D&A
	A-12	Imp Kugmallit H-59	2,193	D&A
1977	A-13	Imp Arnak L-30	4,322	D&A
	A-14	Sun et al Unark A L-24	3,935	D&A
	A-15	Imp Kaumerk G-42	3,181	D&A
1978	A-16	Esso et al Isserk E-27	4,056	Gas Discovery
1979	A-17	Esso Adgo J-27	3,110	Oil & Gas Disc.
1980	A-18	Esso Issungnak O-61	3,533	Oil & Gas Disc.
1981	A-19	Esso et al Issungnak 2 O-61	4,460	Oil & Gas. Disc
	A-20	Esso et al Alerk P-23	3,220	D&A
1982	A-21	Gulf et al E. Tarsiut N-44	3,810	Drilling
	A-22	Esso W. Atkinson L-17		
	A-23	Esso Itiyok M-17		
	A-24	Dome et al Uviluk P-66		

Drillship Wells

Year	No.	Name	Depth	Status
1976	D-1	Hunt et al Kopanoar D-14	1,146	D&A
	D-2	Dome et al Tingmiark K-91	3,351	D&A
	D-4	Dome et al Kopanoar M-13	485	SUSP
	D-5	Dome et al Nektoralik K-59		
1977	D-5	Dome et al Nektoralik K-59	2,791	Oil & Gas Disc.
	D-4	Dome et al Kopanoar M-13	2,793	SUSP
	D-5	Dome et al Ukalerk C-50	2,306	D&A
	D-6	Dome Kaglulik A-75	412	SUSP
	D-7	Dome et al Natsek E-56		
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1978	D-4	Dome et al Kopanoar M-13	4,320	SUSP
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	D-7	Dome et al Natsek E-56	2,687	SUSP
	D-8	Dome Nerlerk M-98	549	SUSP
	D-9	Dome et al Ukalerk 2 C-50	4,953	D&A
	D-10	Dome et al Tarsiut A-25	435	SUSP
	D-11	Dome Kaglulik M-64	144	D&A
1979	D-4	Dome et al Kopanoar M-13	4,320	Oil Discovery
	D-7	Dome et al Natsek E-56	3,520	SUSP
	D-8	Dome Nerlerk M-98	4,339	SUSP
	D-9	Dome et al Ukalerk 2 C-50	4,953	Gas Discovery
	D-10	Dome et al Tarsiut A-25	4,434	SUSP
	D-11	Dome Kaglulik M-64	144	D&A
	D-12	Dome Kenalcoak J-94	2,130	SUSP
	D-13	Dome et al Kopanoar L-34	2,015	J&A
	D-14	Dome Koakoak O-22	210	SUSP
	D-15	Dome et al Kopanoar 2 L-34	181	SUSP
1980	D-10	Dome et al Tarsiut A-25	4,434	Oil & Gas Disc.
	D-12	Dome Kenalcoak J-94	3,475	SUSP
	D-14	Dome Koakoak O-22	3,717	SUSP
	D-16	Dome et al Kilannak A-77	702	SUSP
	D-17	Dome et al Kopanoar I-44	649	J&A
	D-18	Dome et al Orvilruk O-03	3,606	SUSP
	D-19	Dome et al Kopanoar 2 I-44	3,164	SUSP
1981	D-12	Dome Kenalcoak J-94	3,475	SUSP
	D-14	Dome Koakoak O-22	4,365	Oil & Gas Disc.
	D-16	Dome et al Kilannak A-77	2,996	D&A
	D-18	Dome et al Orvilruk O-03	3,606	SUSP
	D-19	Dome et al Kopanoar 2 I-44	4,010	Oil & Gas Disc.
	D-20	Gulf et al N. Issungnak L-86	4,771	D&A
	D-21	Dome et al Irkaluk B-35	2,211	SUSP
1982	D-8	Dome Nerlerk M-98	4,939	
	D-12	Dome Kenalcoak J-94	3,475	
	D-18	Dome et al Orvilruk O-03		
	D-21	Dome et al Irkaluk B-35	2,211	
	D-22	Dome et al Siulik C-07		
	D-23	Dome et al Kopanoar		
	D-24	Dome et al Arluk E-80		

APPENDIX II

SUMMARY OF CANMAR MARINE VESSELS,

BEAUFORT SEA 1981.

A. CANMAR MARINE FLEET

NAME	CLASSIFICATION/FUNCTION	REMARKS
Explorer I	Drillship	Ice Strengthened
" II	"	" "
" III	"	" "
" IV	"	" "
Supplier 1	Supply/Ice Breaker/Tug/ Anchor Handling	Ice Class 2
" 2	Supply/Ice Breaker/Tug/ Anchor Handling	" " "
" 3	Supply/Ice Breaker/Tug/ Anchor Handling	" " "
" 4	Supply/Ice Breaker/Tug/ Anchor Handling	" " "
" 5	Tug/Survey/Coring	" " B (Shallow Draft)
" 6	Tug/Supply/Anchor Handling	" " C
" 7	Tug/Supply/Anchor Handling	" " A
" 8	Supply	" " D (Class 2 Hull)
Kigoriak	Ice Breaker/Tug/Anchor/ Handling	" " 3
*Arctic Sun	Harbour Tug	21 m Twin Screw
*Canmar Widgeon	Tug/Supply/Anchor/Handling Standby	Ice Class A1 (E) Ice Strengthened Class "C"
*Canmar Teal	Tug/Supply/Anchor Handling	
*Canmar Tugger 1	Tug	37 m Twin Screw Class "A" Bow Thruster, Winch, Crane.
*Canmar Tugger 2	Tug/Anchor Handling/Fire	46 m Twin Screw. Class A + 1A1.
*Canmar Tingneak	High Speed Tender	37 m Triple Screw, 42 Passengers, 30 kts.

*Canmar Sea Eagle	Push Tug	40 m Ocean Service.
*Canmar Shuttle	Sea Fuel Barge	Fuel Tanks 22 000 tonnes, Deck Tank 12 000 tonnes.
*Canmar Constructor	Accom/Work Barge	181 tonnes, 9.1 tonnes cranes. Accom 212 Persons.
*Canmar Careen	Dry Dock	137 m x 160 m Drydock 4 Supply Boats at a time or any Dome/Canmar Ship.
Barge 1	Crane Barge	Work barge, accommodation

*1981 Additions to Canmar Marine Fleet.

B. 1981 CHARTERED VESSELS

NAME	CLASSIFICATION/FUNCTION	REMARKS
Beaufort Sea Explorer	Tug/Surveying	
Mary B VI	Supply	Ice Class 2
Arctic Taglu	Tug	
Edwin Lindberg	Tug	
Dorothy Robinson	Tug	
Beverly Lambert	Tug	
Cecelia Hall	Tug	
Camp 205	Accommodation Barge	
Camp 208	Accommodation Barge	
Geopotes X	Dredge	
Aquarius	Dredge	
Hendrik Zanen	Dredge	
Imperial Adgo	High Speed Crew Boat	
Norweta	Transportation/Standby	Former River Ferry
Pilot II	Harbour Tug	
Orion	Tug	Ocean Service
Edward O. Vetter	Survey	Geophysical
J.S. Keen	Harbour Tug	
GSI Mariner	Survey	Geophysical

APPENDIX III

SUMMARY OF DRILLING OPERATIONS

WELL SCHEMATICS:

FIG. 1 DOME et al KOPANOAR 2I-44
FIG. 2 DOME HUNT GULF KOAKOAK 0-22
FIG. 3 DOME et al KILANNAK A-77
FIG. 4 GULF et al NORTH ISSUNGNAK L-86
FIG. 5 DOME SUPERIOR ORVILRUK 0-03
FIG. 6 DOME HUNT KENALOOAK J-94
FIG. 7 DOME HUNT IRKALUK B-35

Drilling Summary

Seven wells were spudded or re-entered from previous year's drilling during the 1981 Beaufort Sea Drilling Season; the location of these and others drilled in the Beaufort Sea, commencing in 1972 are shown in APPENDIX I - MAP No. 2.

		D.A.	SPUD OR RE-ENTER*	RIG RELEASE	STATUS
1.	Dome Gulf Hunt Kopanoar 2I-44	967	81-07-17*	81-10-28	Suspended (4015 m)
2.	Dome Hunt Gulf Koakoak O-22	946	81-07-21*	81-10-31	Suspended (4365 m)
3.	Dome et al Kilannak A-77	966	81-07-22*	81-09-04	D + A (2996 m)
4.	Gulf et al North Issungnak L-86	978	81-07-18	81-10-16	Abandoned (4771 m)
5.	Dome Superior Orvilruk O-03	962	81-09-07*	81-09-18	Suspended (3606 m)
6.	Dome Hunt Kenalooak J-94	909	81-09-22	81-09-25	Suspended (3481 m)
7.	Dome Hunt Irkaluk B-35	984	81-09-27	81-10-22	Suspended (2211 m)

1) Kopanoar 2I-44 (Figure No. 1)

Kopanoar 2I-44 was re-entered 81-07-17 from Explorer I having been spudded 80-08-02 and drilled to 3164 m. Initial pressure integrity testing of the 244 mm casing resulted in a failure at ± 430 m. A remedial casing patch was successfully run and pressure tested. After drilling out the cement suspension plug at 676 m and cleaning the hole to the bottom of the 244 mm casing retainer at 2490 m, a pressure test revealed a further leak at ± 767 m. Cement was squeezed through the leak to fill the 244 mm X 406 mm annulus and the casing held pressure estimated to be adequate for further drilling operations. The hole was reamed and conditioned to 3164 m and a suite of logs were run. 178 mm casing was landed at 3140 m and cemented to a depth above the 244 m casing shoe. On 81-08-20, the drillpipe was pulled to the casing shoe and hung-off due to poor weather conditions. Drilling of new hole resumed without incident to 3711 m. On 81-08-31 an Ice Alert 4 prompted the hanging-off of the drillpipe

to 3760 m where core No. 1 was cut. Coring proceeded successfully and an DLWD (downhole logging while drilling) tool used for the first time had proven useful for formation correlation. Drilling continued to 4015 m with mud density increasing to 1930 kg/m^3 in order to control high gas levels and differential pipe sticking problems. It was then decided to run a 217 mm liner from 4010 m to 2504 m and test the well. A minor gas kick, while cleaning out to the top of the liner, was controlled by increasing the mud weight to 2000 kg/m^3.

A drill stem testing program consisting of 8 tests was conducted during the ensuing five weeks to appraise the same reservoir penetrated at the Kopanoar M-13 well. Time was lost because of severe storms, the worst coming in early October when an anchor cable parted forcing the drillship to leave the hole after the marine rise (LMRP) had been disconnected. After the testing program was terminated due to encroachment of the ice, the well was suspended with cement plugs set in place at appropriate zones and the Explorer I pulled anchors and returned to winter moorage on 81-10-30.

2) Koakoak O-22 (Figure No. 2)

Koakoak O-22 was re-entered 81-07-21 from Explorer III having been spudded 79-11-05 and drilled to 3717 m in 1980. During reaming of the hole below the 244 mm casing which had been set at 2685 m, the drillpipe became differentially stuck at 3512 m. After several days of trying to free the pipe, the hole was sidetracked at 2714 m and deviated around the backed off pipe to a core point at 3484 m. Two cores were recovered and the DLWD tool was run while drilling to 4039 m. After logging, and while coring, a coring tool became stuck in the hole and had to be recovered. A 178 mm liner was run at 4036-2498 m and cemented and the overlap between the liner and the 244 mm casing had to be squeeze cemented to hold a required pressure. The hole was turbo drilled and cored to 4361 m and logs were run. A 127 mm liner was then run from 4357-3815 m, the overlap had to be squeeze cemented three times in order to obtain a minimum level of pressure integrity.

The testing program was abbreviated due to ice conditions and the well was suspended and Explorer III pulled anchors to leave for McKinley Bay on 81-10-31.

3) Kilannak A-77 (Figure No. 3)

Kilannak A-77 was re-entered 81-07-22 from Explorer IV, having been spudded 80-06-23 and drilled to 702 m. The hole was drilled to 1089 m, logged, and 240 mm casing was set at 1077 m. Drilling proceeded to 1446 m when the drill string had to be hung-off in the wellhead due to an ice encroachment upon the drillsite. After logs were run at 1610 m, a floe of first year ice forced the decision to again hang-off the drillpipe on 81-08-10. Conditions improved to allow drilling to progress to 2996 m and a suite of logs was run.

Deteriorating ice conditions, and logs indicating the absence of permeable horizons or hydrocarbons, prompted the decision to abandon the well on 81-09-04, and sail Explorer IV to the Orvilruk O-03 wellsite.

4) N. Issungnak L-86 (Figure No. 4)

Explorer II was contracted by Dome to Gulf Canada Resources to drill a well at the Issungnak L-86 location situated some 10 km North of the Esso Issungnak O-61 oil and gas discovery. Dredging of the glory hole commenced 81-07-02, however, ice conditions worsened and the drillship had to standby the location until 81-07-10. The glory hole was excavated to 47 m and the well was spudded on 81-07-18.

Drilling proceeded uneventfully and casings were run and set at 208 m (762 mm), 778 m (508 mm) and 2296 m (340 mm). Drilling continued to 3584 m when ice conditions necessitated the hanging-off of the drillstring in the wellhead, the pulling of the LMRP and shearing the guidelines on 81-09-01. Conditions improved, allowing a suite of logs to be run the next day, however, the drillship was forced to disconnect from location and standby until 81-09-06. Explorer IV then re-connected to the well and 244 mm casing was run and cemented at 3572 m. Drilling continued to 4572 m when the mud density was raised from 1220-1410 kg/m^3 to control gas influx. New hole was drilled to 4631 m and, while tripping for a bit, the drillpipe parted at $\pm$ 3996 m. On 81-09-28 the pipe ("fish") was recovered but had to be pulled into the 340 mm casing hole to hang off in rough seas. With the vessel still waiting on weather, an anchor wire parted and a fairlead was damaged. After the storm had subsided, divers untangled and re-established the guidelines. By 81-10-06 operations had resumed and the drillpipe and "fish" were recovered. Drilling continued to 4771 m and the mud density was increased to 1680 kg/m^3 to control gas influx. During the running of logs, the dipmeter tool was lost in the hole and could not be retrieved past 1907 m. A casing collar locator revealed the 244 mm casing had parted at $\pm$ 1905 m and a decision was made to abandon the well. Explorer III plugged the well, pulled anchors and departed the location on 81-10-17.

5) Orvilruk O-03 (Figure No. 5)

Orvilruk O-03 was re-entered 81-09-07 from Explorer IV, having been spudded 80-07-09 and drilled to 3606 m. Ice conditions had not permitted the retrieval of the BOP stack and drill string the previous year. The LMRP was lowered to the stack and, in order to activate the rams of the BOP, it was decided to hot-line the stack. No pressure was found under the rams and the well bore was found to be in a static mode. The BOP stock and drillstring were recovered, the well properly suspended, and Explorer IV departed the location on 81-09-18 for the Kenalooak well-site.

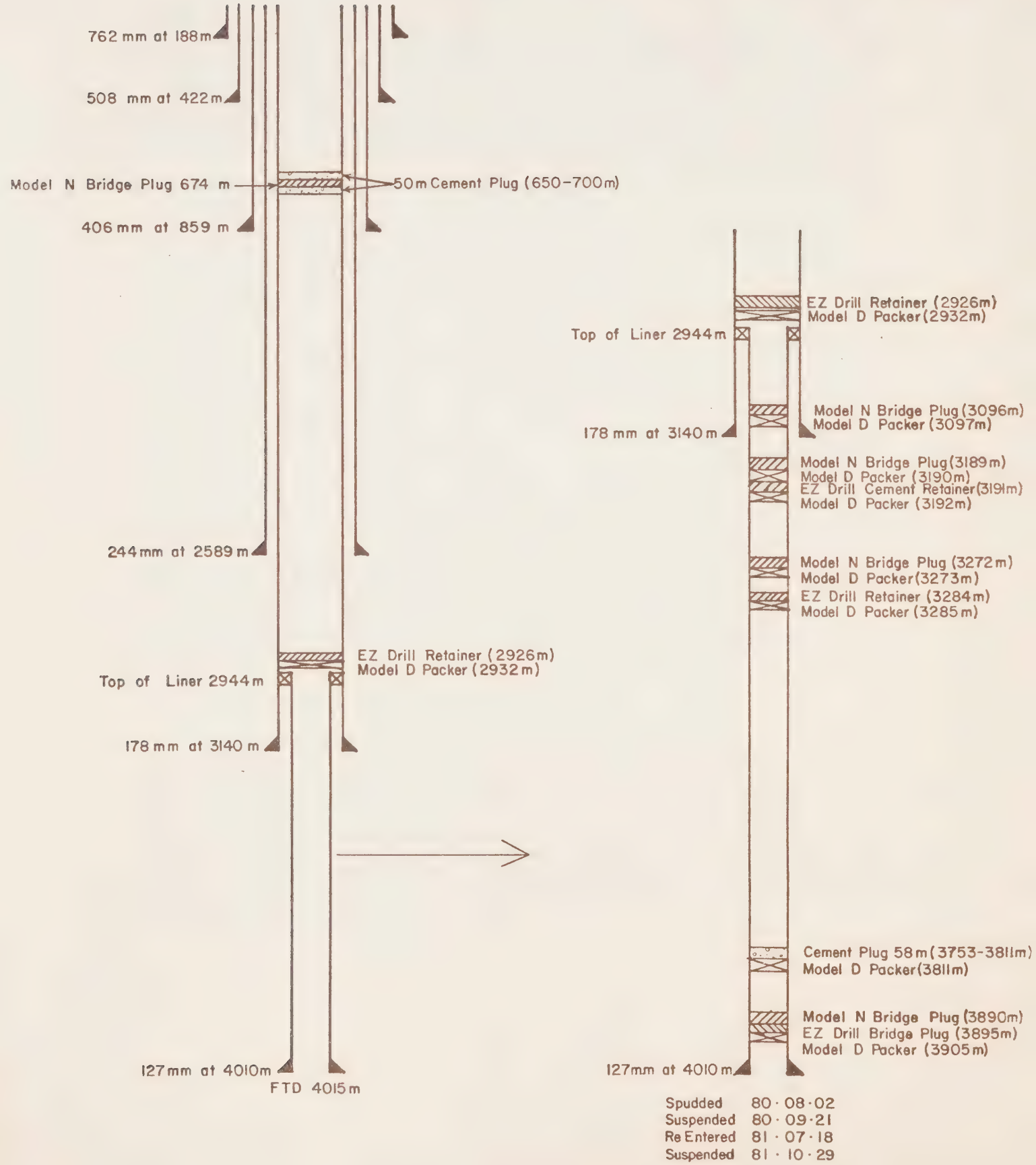
6) Irkaluk B-35 (Figure No. 7)

Irkaluk B-35 was spudded 81-09-27 from Explorer IV in 56 m water. The 762 mm conductor was landed and cemented at 200 m. While drilling to 700 m, the hole was displaced from seawater to 1200 kg/m^3 mud to stabilize the well. The 508 mm casing was landed and cemented at 693 m. During the drilling of the subsequent section of hole, high gas readings were encountered and it was necessary to raise the mud density to 1500 kg/m^3. At 1608 m, gas had to be circulated out of the drill pipe to stabilize the well. Drilling continued to 2211 m with periodic drilling breaks to circulate out gas influx. The well was conditioned, a suite of logs run and the 340 mm casing was set and cemented at 2198 m. The well was suspended 81-10-22 and the Explorer IV departed for McKinley Bay.

DOME GULF HUNT KOPANOAR 21-44 DA 967

Well Schematic

(RT to Sea Floor 58.1m)

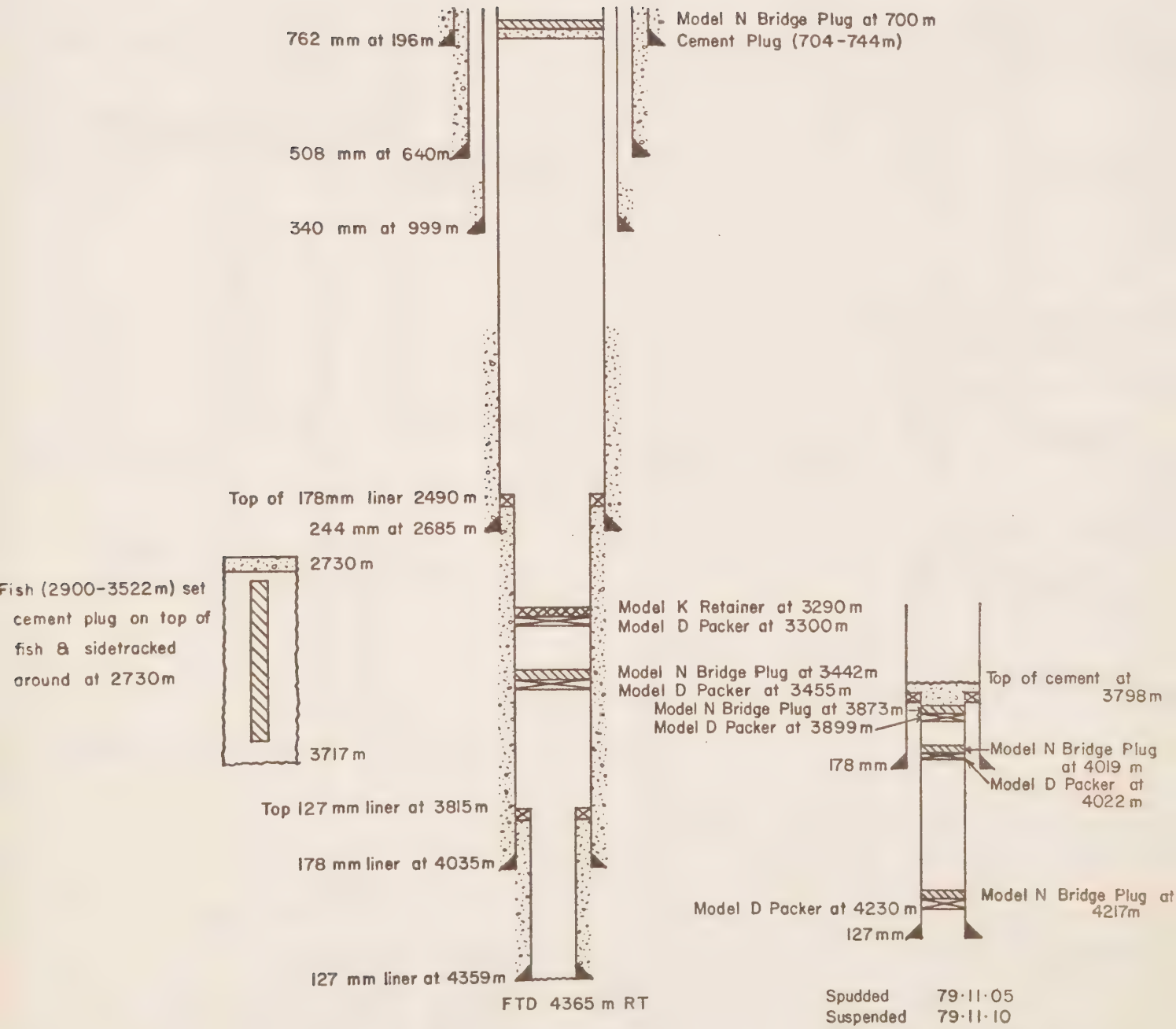


Spudded	80 · 08 · 02
Suspended	80 · 09 · 21
Re Entered	81 · 07 · 18
Suspended	81 · 10 · 29

DOME HUNT GULF KOAKOAK 0-22 DA 946

Well Schematics

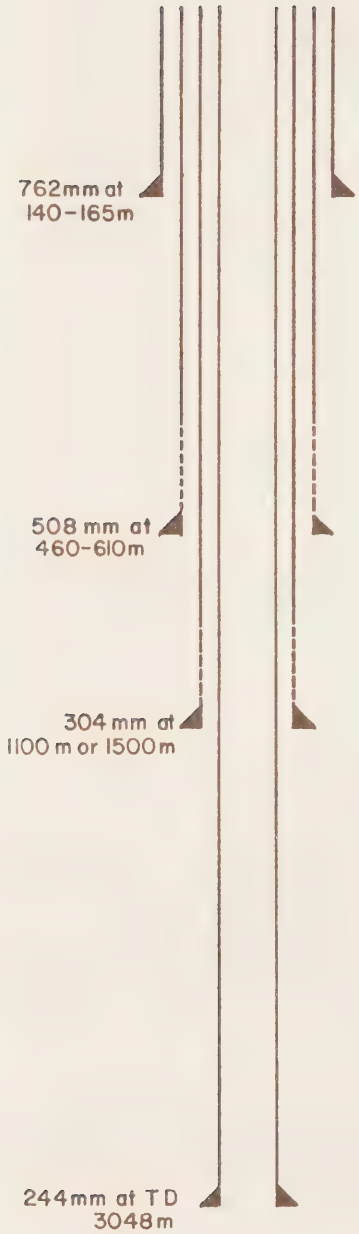
(RT to base Glory Hole 63.1m)



Spudded	79·11·05
Suspended	79·11·10
Re Entered	80·07·08
Suspended	80·10·05
Re Entered	81·07·20
Suspended	81·10·30

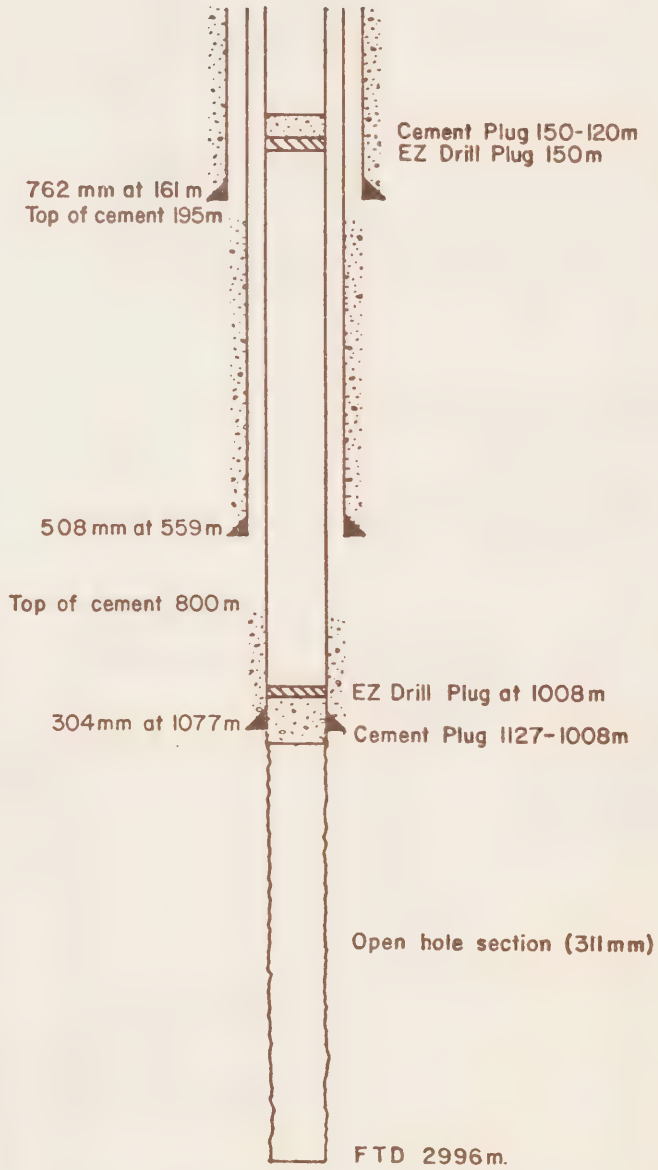
DOME et al KILANNAK A-77 DA 966

Proposed Casing Depth



Well Schematic

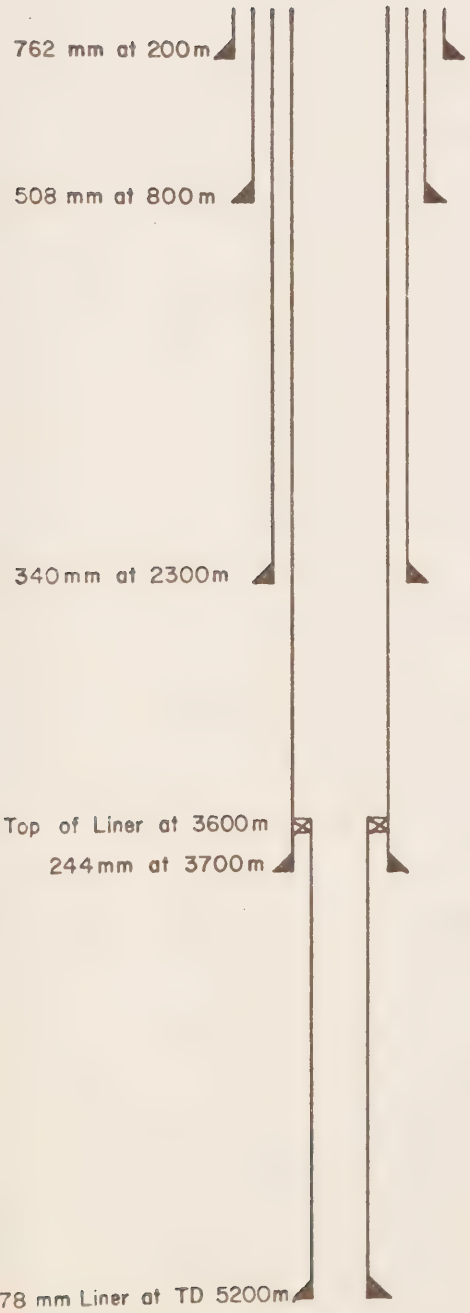
(RT to Base Glory Hole 67m)



Spudded	80·06·23
Suspended	80·07·09
ReEntered	80·09·10
Suspended	80·09·19
ReEntered	81·07·24
Abandoned	81·09·04 (2996m)

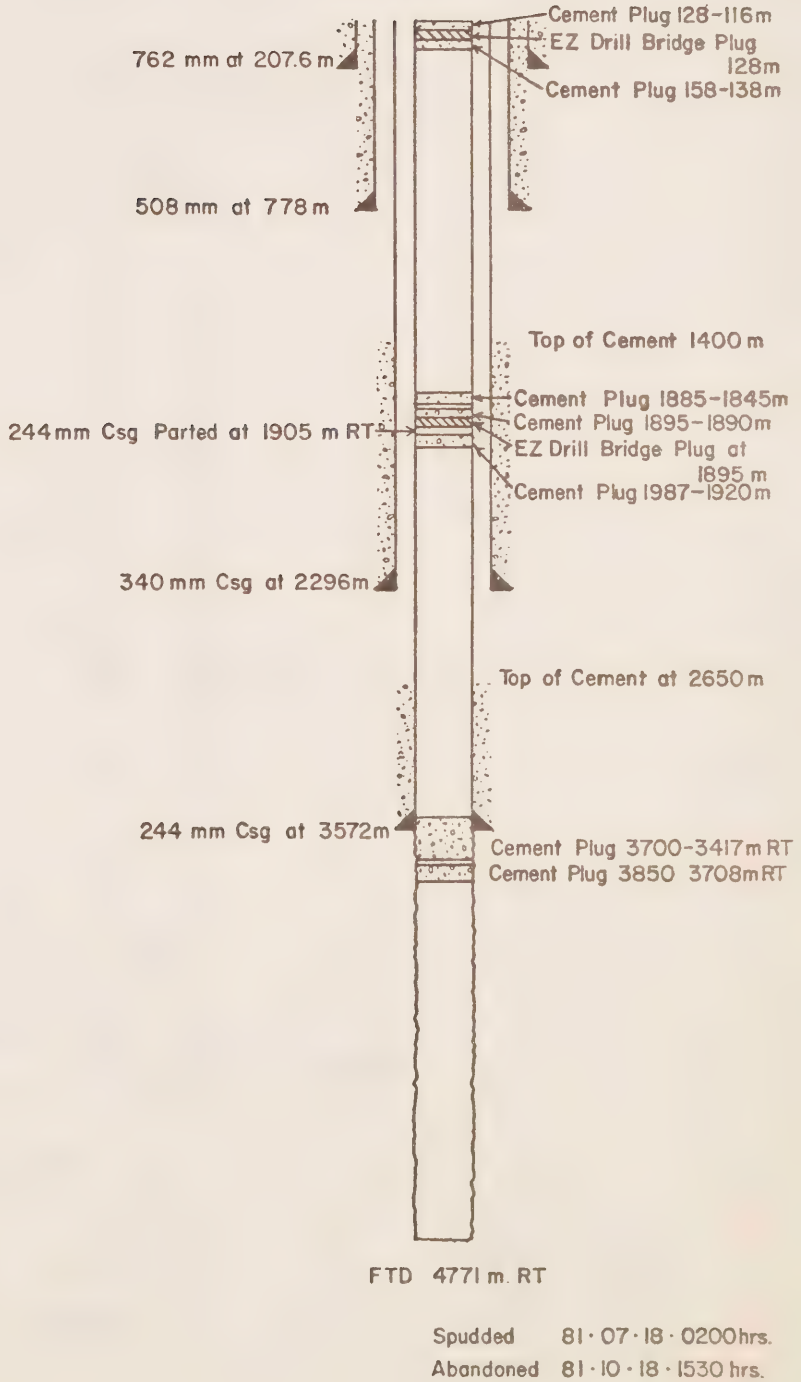
GULF et al NORTH ISSUNGNAK L-86 DA 978

Proposed Casing Depth



Well Schematics

(RT to Glory Hole Base 47.5 m)



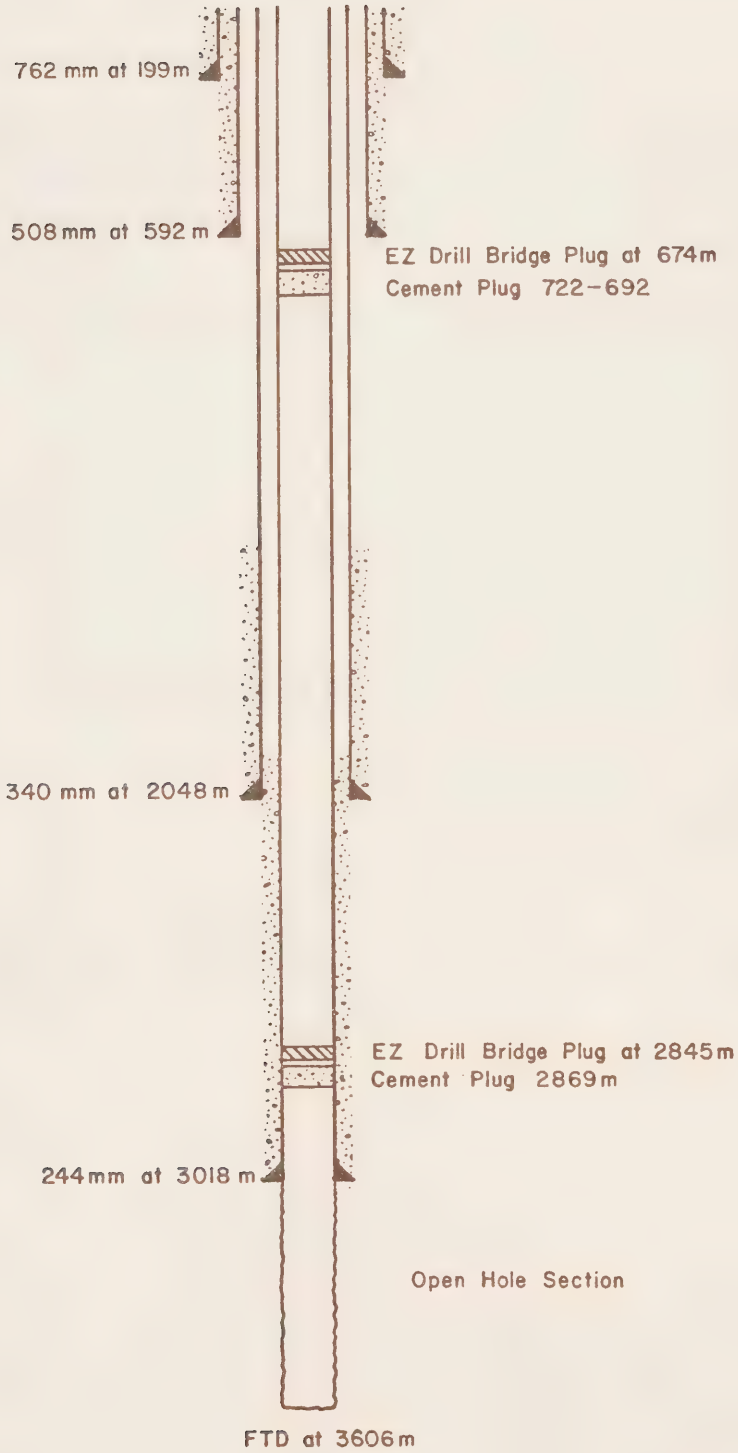
Spudded 81 · 07 · 18 · 0200hrs.

Abandoned 81 · 10 · 18 · 1530 hrs.

DOME SUPERIOR ORVILRUK O-03 DA 962

Well Schematics

(RT to Sea Floor – 68.3m)

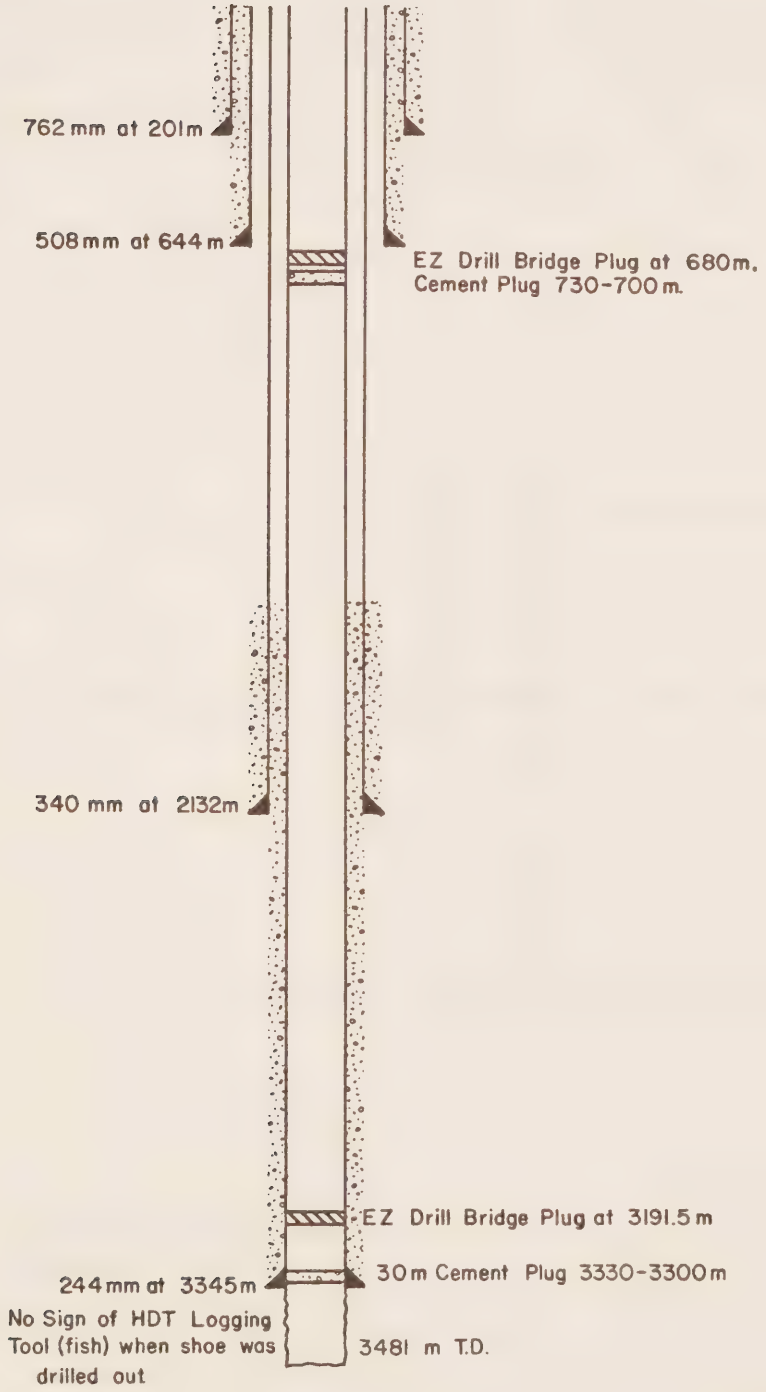


Spudded	80·07·09
Suspended	80·09·11
Re Entered	81·09·12
Suspended	81·09·18

DOME HUNT KENALOOAK J-94 DA 909

Well Schematic

(Rt to Sea Floor 82m)

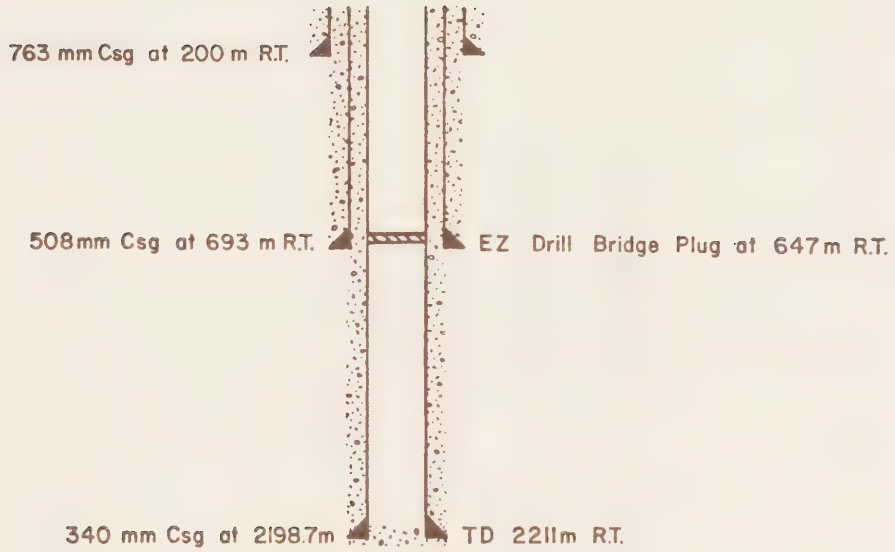


Spudded 1979·09·20
Suspended 1979·10·22
Re Entered 1980·08·12
Suspended 1980·09·08
Re Entered 1981·09·23
Suspended 1981·09·25

DOME HUNT IRKALUK B-35 DA 984

Well Schematic

(Rotary Table to Sea Floor - 68.55m)



Spudded 1981·09·27·1200 hrs.

Suspended 1981·10·21·2030 hrs.